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FIRE CONTROL NOTES

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 16 Number 1

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the

TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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Forest Service, Washington, D. C.

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CONTENTS

PRIMARY BASES AND IDEAS FOR FIRE CONTROL PLANNING ON CALIFORNIA NATIONAL FORESTS

S. B. SHOW[1]

Fire control planning is taken to mean the rational determination by professionals of that balanced and integrated assembly of forces, means, and methods calculated to hold fire losses to predetermined maxima, regularly and in each resource management unit such as watersheds, working circles, and range allotments.

In the area discussed, identification and measurement of the many independent variables involved and synthesis of findings of fact and informed estimates into fire control systems were brilliantly begun by Du Bois in 1913 and have been continued by others, at variable intensity and pace and with variable ingenuity, imagination, boldness, and method. Concurrently, allowable burn goals have been set and reset at irregular intervals, most recently for northern California in 1930 and for southern California in 1939.

The philosophical ceiling of planning, except on a few small timber sale and watershed areas, has been to hold losses to goals under the *average* worst conditions expected from the recorded and short period (now circa 45 years) experienced in organized fire control. Acceptance of this limited ceiling in and of itself insures that losses must exceed the tolerable limits under worse than average worst conditions, and thus that losses as averaged for almost any term of years will exceed the allowable.

The actual fire record is dominated by the fact that no design system has ever been fully applied. Closest approach to full application was of the order of 80 percent, during early C.C.C. and early World War II years. Currently the rate is of the order of 60 percent. The compound effect of inadequate design incompletely applied goes far to explain in general terms the continued frustration in attaining the goals set by the Forest Service for itself. The annual Regional Board of Fire Review, begun in 1924, regularly identified major fires which became large because of such deficiency factors as indirect visibility and consequent delayed discovery; unavoidable longer than standard travel time by first attack forces; unavoidable lower than standard first attack strength of both men and machines. Such built-in quantity defects inevitably lead to larger than necessary fires, except under conditions of less than average difficulty.

A further general fact, contributing to the record, is that more than a few small fires are lost and move on from A and B to C, D, E small, and E large because of less than superior quality of initial attack, a condition resulting primarily from employment, training and equipping policies and practices imposed by budgetary authorities, and by the commonly exceedingly tight fits in quality of first attack as imposed by nature. The Board of Review also identi-

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fied many first attack failures resulting in large fires which were chargeable to mediocre or insufficiently trained leaders who, faced by the instant moment of decision on a brisk small fire, selected the wrong course. Such quality defects, too, are good enough only under conditions of less than average difficulty.

Concurrently, too, the physical difficulties and magnitude of the problem have continued to grow. Very rapid initial spread has become more general. Volume of fuels and resistance to control have increased greatly. Industrial and recreational use, and thus exposure to risk, affects a larger area each year. Utilization of timber, overutilization of range, type changes caused by fire have greatly increased the fast-spread, high-hazard area. The frequency of critical or difficult seasons, judged by their own context rather than by absolute standards, averaging 3 out of 10, shows no tendency to decrease. The most recent major lightning storm caused more fires than any predecessor.

In total, we deal with persistent, frequently recurring and increasingly difficult control problems on a larger and larger area. These form the general terms of the problem.

A broad perspective of the total effect of the several inadequacies and unbeneficial changes is given by the facts that during the period 1921-50 the annual burned area on the 13 or 14 northern California national forests *as a group* has been held to allowable only 6 times; on the 4 southern California national forests only once; for the Region as a whole only 4 times. Using individual national forest and year record as the unit and for the same period, the allowable has been exceeded in northern California in 172 out of 390 cases and, omitting the Eldorado and Inyo, in 166 out of 330 cases—just about half; in southern California, in 76 out of 120 cases; for the Region in 248 out of 510 cases. Of 18 national forests, 16 repeatedly fail to hold losses to allowable.

The indubitably intolerable forest and year records (arbitrarily those with 10 times annual allowable) number for the 30-year period 43 in northern California, 20 in southern California.

In northern California the trend has been toward reduction in the frequency by both measures; in southern California the lowest frequency was in the decade 1931-40. But in the north, 42 out of 130 cases in the decade 1941-50 exceeded allowable and 9 out of 130 cases exceeded 10 times allowable. In the south during the period 1921-50 there have been 10 seasons, or one-third of total, rated as critical or more difficult, as judged by frequency of bad forest and year records—further indication of the persistence of the imbalance between end and means.

Perspective then would say that the concurrent significant and continuing advances in means and skill have slowly gained on the goal in northern California, but have by no means attained it; in southern California have lost ground from a high point still very far from the goal.

Similar criteria applied to resource management units would surely yield depressing conclusions. It is axiomatic that a satisfyingly low burned area figure for a national forest, subregion or

region, type or group of types, conceals severe damage to or wreckage of individual resource management units. To hold losses in such units to tolerable size involves holding individual fires to not over say 1,500-2,000 acres.

One general conclusion from all of this would seem to be that the case for "adequate protection" has never been made so convincingly that budgetary authorities feel compelled to act on it. The thing proves itself.

This note tries to suggest some of the kinds of information and some of the kinds of consideration which, viewed in perspective, would support powerfully a really full-scale program, such as is required to break out of the past and present losing stalemate. The methods, techniques and content of planning, and plan are not dealt with. It considers the basis for planning rather than planning itself.

The first item might be a re-examination of goals, which in northern California stand at 0.2 and 0.5 percent average annual for timber and brush types. Both were set by informed judgment (1930) when: (1) Complete destruction of timber stands by fire was far less prevalent than today. (2) Great areas were appraised at zero or negative value stumpage, as were the true firs generally, and there was much informed pessimism as to whether such areas would ever be used. (3) The potential of fires in low-value temporary fire-caused types to smash into and destroy adjacent high values was clearly given less than full weight in the brushfield objective. (4) Very much more area was untouched by logging or other fire-causing uses.

Today the once negative value areas and species are salable at rates several times as high as the 1930 rates for then accessible pine. It would seem then that what was good enough for negative value or \$2 stumpage is not good enough for \$10-\$20 stumpage.

The allowable rate for brush areas is particularly weak. As to watershed values, the figure 0.15 percent, set for southern California in 1939, is fairly solid. Like stumpage, water values and thus watershed values have zoomed from speculative to actual in many places.

The effect of greatly intensified demand for resources, created by explosively growing population and expanding economy, is to reduce tolerable loss rates; this relation can be grasped by intelligent laymen.

Point two might be the accumulated effect of fire losses on the total pool of timber, most simply expressed as the area of nonrestocking brushfields. The present total of 2.1 million acres found by disciplined survey methods is almost 20 percent greater than that found 35 years earlier by ground examination, using far less exact methods. The most elementary totaling of known major fires only would confirm that loss of productive timber area has not been halted. That, to repeat, is simply not good enough for the kind of economy and society now existing.

A nagging question which has to be faced as point three is an estimation of the worst possible that might occur—that is, a finding broadly comparable to the "design storm" of the engineers.

It seems to be generally agreed by experts that post- or interglacial periods are characterized by irregular and pulsating desiccation. Such things as the drying up of evaporation pans in the Great Basin, the retreat of the big trees to most favorable islands in the Sierra, the isolated relict stands of conifers on southern California mountaintops, all tend to confirm the conclusion that the current period is indeed one of desiccation.

Climatic pulsations of the geologically recent past have been demonstrated and dated by tree ring analysis. Within the short period of formal weather records, drought-sensitive trees reflect in ring growth the fluctuating ups and downs of current or immediately preceding seasonal precipitation, and it is thus a fair assumption that growth reflects seasonal precipitation for earlier periods.

Using drought-sensitive big cone spruce in southern California Schulman found that, for example, the 27-year period 1571-97 had twice as great an accumulated deficit as that of any period during the century of weather record; that ring growth in individual years during that period was as little as 5 percent of average, whereas from 1896-1944 growth has never been less than 25 percent of average. During the latest dry period measured by tree rings, 1924-34, average minus departure from average was 15 percent; during the 1571-97 period it was 24 percent.

Huntington's earlier work on bigtrees showed irregular pulsations in ring growth of varying duration and degree of departure from average, back more than 3,000 years. Within the short period of weather records he, too, related growth to seasonal precipitation.

Fire control people would at once insist that short-period conditions within a season commonly are more controlling on fire behavior than the general character of the season. Generally dry seasons such as 1913 (73 percent) and 1925 (67 percent) may be easy fire seasons because of favorable distribution of precipitation; or like 1924 (57 percent), 1928 (72 percent), and 1929 (73 percent) they may go down in fire control history. Or generally wet seasons such as 1922 (155 percent) or 1944 (125 percent) may have great fires due to short unfavorable periods; or like 1935 (127 percent) and 1937 (178 percent) they may be pointed to with pride.

The point is that the ring-measured dry period 1924-34 produced 6 critical years ('24, '26, '28, '29, '31, '34) whereas the 1935-44 wet period produced but 3 ('36, '39, '44).

It would seem prudent to assume that the worst possible, as measured by length and depth of rainfall deficit periods and excessive departure from average of individual years, has not been experienced during the brief half-century span of organized fire control.

One measure of worst possible for short periods as experienced to date is the fire spreading with great rapidity from the start, making a great and continuous first run of say 10,000 to 20,000 acres, and on which the verdict is that standard first attack by conventional means is ineffectual. Such fires always occur where annual grass is the fire carrier. There have been but few, but they

still happen. Whether the worst possible, as thus measured, has happened would seem uncertain.

Another measure of short-term worst possible is the "dry" lightning storm causing so many starts that large areas are saturated and standard control forces are overwhelmed. The latest experience (1951) being worse than previous recorded worst, suggests that worst possible has not been experienced.

In total it seems strongly probable that worst possible, by whatever single measure and particularly as a theoretical combined total (e.g., excessively dry season in prolonged and deep dry period; critical period within season; numerous simultaneous starts in fast-spread types and/or poorly accessible areas), has not been experienced.

A fundamental preparation to planning and to forceful and convincing presentation of the case is thus estimation of the worst possible—the design fire situation. A study of the design fire situation which created a fire storm and overwhelmed the then control forces in Victoria, Australia, in 1939 might afford a sobering background for appraising the potential locally.

Budgetary people have been trained, albeit reluctantly, to accept professional planners' design for such costly public necessities as flood control dams, battle fleets, air forces, highway systems, school systems. Fire control planning, as a profession, has by no means established the basis for and the validity and inexorable inescapability of its findings to the same degree.

Fire control planners can learn from other professional planners such as those noted, and particularly in the arts and skills of presenting the case in unified and understandable simplicity. The air force talks of the wing, which by design and definition carries supporting and ancillary services. The unit for the navy is the battle fleet—and design supports. Highway planners deal with peak capacity. And so on. The essential components of fire control design, once the goal is set, are understandable by the intelligent layman, if they are put that way.

On experience and aiming to prepare for estimated worst possible, planning to design situations deals with two general cases. These are:

1. The more widespread areas for which first attack plus followup, standardized as to speed, strength, and quality are calculated to do the job. Here nature, expressed in rapid initial spread, leaves no room for fumbling, and imposes the need for an elite corps of first attack leadership. Planners will have to devise arithmetical measurements of the vast difference in results (in a word, failure or success) between mediocrity and superiority in first attack. From such a documented finding will follow recognition of the measures required to attract and hold elite quality men.

Both quantity and quality questions are involved.

For a good many years it was possible to concentrate first attack coverage on the well marked zones in which fires had started, and to go light on the considerable areas free from starts and those, such as true fir types, where slow attack was sufficient.

Expansion of use, particularly logging, has increased area subject to risk, and has changed large areas from old growth to cutover. Probably prudence now dictates full coverage of all areas.

2. The more specialized areas where runaway starts cannot be caught by standard attack. Perhaps no more than 1 to 3 percent of starts on the annual grass areas are involved, but areas burned, costs, and losses from this minority of fires are excessive and will continue to frustrate the whole project on many national forests.

Special measures in addition to standard attack are dictated by nature. Rigid exclusion of risk, moving use from fire to nonfire seasons, fireproofing of risk areas, block control, insulation from adjacent risk areas, change of cover and fuel type from more to less hazardous, intensification of control organization, particularly in quality: all have been tested on a limited scale but not persistently for a long period, and all, when and while fully applied, have proved effective.

Here planners must establish and sell a new and unavoidably costly idea. Integral to a really competent design and to operation of a resulting organization is a group of supporting technical services, lacking which operations will falter. Included are definition of hazard conditions and sure forecasting of them; research in fire behavior, fire equipment, and prevention and control methods; continuing analysis of operations and of changes of the localized terms of the problem; improvements in teaching material and texts and in training programs; intensification of recruiting and selection programs; devising and improving methods for making desirable type changes and large scale programs to apply them. For each of these, work has been done and is under way, but to a scale and at a pace far below evident and imminent needs.

Competent planning deals with things—numbers of lookouts, first attack crews, tankers, line-building machines; miles of telephone lines, roads, trails; back-of-the-line specialists—all the complex array, each element of which has a significant place in the whole, and which can be packaged in terms of major fire control units, thus attaining simplicity and avoiding confusing complexity.

All of these have price tags which, compared to the vanished unit costs of not many years ago, are shocking. But they must be faced and made as palatable and inescapable as may be to reluctant budget authorities.

Much of the noncontrollable increase in unit costs comes, of course, from reductions in buying power of money, both for things and people; from softer terms of employment—8-hour day, 40-hour week, overtime; from a sharpened social conscience—camp sanitation, safety measures; from the monstrous ballooning of formal requirements for paper work. None of these is controllable by the Forest Service.

But the most binding change in price tag is in the annual cost of the superior guard or crew leader. For many years the Forest Service got and retained many good men on the basis of employment during fire season only. Interest in the job was one element. A liking for or acceptance of an economically unstable streak of

lean and a streak of fat life was another. But the absence or scarcity of superior competitive employment—in the sense of long-term or yearlong employment, wage rates, chance to advance and/or reasonable assurance of a career job was the dominant element. In taking advantage of its superior power as an employer, the Forest Service long held down costs—and failed to establish the guard position as a desirable career job.

Planners have to accept that to get and hold men of the superior quality dictated by the basic terms of the problem, the erstwhile short-term guard job has to be recalculated and built up to meet competition in a world where good men can demand and get job security and continuity at competitively set levels of wages and supplemental benefits. The inescapable fact is that a fire control system, however well designed, is no stronger than the men operating it. Mediocre quality of the human material causes structural failures as great as do substandard steel and concrete in an otherwise well-designed flood control dam. Design includes strength of material as well as kinds and quantities.

If the inevitable and noncontrollable terms of the design problem are accepted, the resultant design will have a very large number of man-days per year available for other useful work outside the fire season and during low-hazard periods within the fire season. Vast quantities of such work lie undone outdoors in each protection unit. The totality can readily be broken down into smallish projects, each of which can be defined by specifications removing the magic and mystery from technical works, and thereby come within the competence of first attack crews and leadership. Any officer can draw up a long list of projects which, as accomplished, better the chances for success of the fire control project as a whole.

Fire control planning thus has boundaries broader than those commonly accepted in the legalistic formalization of budgets. It is, for example, vital to displace cheatgrass with crested wheatgrass on areas where such a type change will most benefit the fire control project rather than on areas most favored by cowmen, cows, or grazing experts. So for establishing, tending, and fireproofing timber stands to replace brush on areas most beneficial to fire control rather than on areas most favored by timber experts. So for tending and fireproofing already established stands, etc.

An idea to be worked out and sold is that fully feasible and planned out-season use of a full design fire control system will both, over a term of years, decrease the fire control job and increase the usable pool of resources. This is basically a bargain—a two for the price of one deal—and has a greater allure than the essentially negative idea of avoiding or preventing losses. It is well to appraise the political potency of "reforestation," "range reseeding," and "upstream flood control," which are positive and satisfy the deep inner urge of nontechnical people of good will for constructive ideas and programs to support.

It is worth speculating, too, whether a more specific identification of resource development programs as a handmaid of fire

control—a two for one deal—might not greatly increase the political potency of such propaganda. A successful marriage of the "adequate fire control" and "resource development" ideas, plans, and programs would, it is submitted, strengthen both.

Any study of, and pondering over, the fire control experience to date in this persistently difficult area must accept that the problem is not solved and will not be solved by a deficient and partially applied design. No matter how skillfully and luckily the available means are spread; no matter what the devotion to duty of the people concerned; the past and current imbalance between means and end must continue to produce insufficient results.

The central idea of this note is that the prime need is to restate and redefine the problem and needs in their true nature and stature as proved the hard and costly way. This imposes acceptance, measurement, and pricing of new ideas and concepts, some of which are suggested, and are widely accepted in dealing with other sorts of public programs for no more convincing reasons than apply to the fire control project. The real public cost of inching along toward the unattained and perhaps receding goal can be and needs to be restated emphatically and convincingly.

Imaginative, bold, and unifying ideas are prerequisite to a level of fire control planning which may hope to break out of the straightjacket of chronic undernourishment.

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FIRE EXTINGUISHERS, THEIR TYPES AND USE. II. THE DRY CHEMICAL EXTINGUISHER

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Everyone should have a basic knowledge of fire extinguishers and the type or class of fires on which these extinguishers are effective. No one type of fire extinguisher is effective on all classes of fires. These classes are as follows:

Class A fire.—A fire in paper, wood, cloth, excelsior, rubbish, etc.—or what we call forest fuels. For Class A fires the *quenching and cooling* effect of water is required.

Class B fire.—A fire in burning liquids (gasoline, oil, paint, cooking fats, etc.) in which a *smothering* action is required.

Class C fire.—A fire in *live* electrical equipment (motors, switches, fuse boxes, transformers, appliances, etc.). A *nonconducting* extinguishing agent is required.

To be sure, a fire may start as one class and then quickly develop into a second class—or even a third. In this case, it is necessary to use one or more types of extinguishers or methods to control the fire.

Let's remember, too, that fire extinguishers are first-aid treatment only. It's the old rule of "get 'em while they're small." There are three basic rules in extinguishing a fire with an extinguisher: (1) Locate the fire, (2) confine it so that it will not spread, and (3) extinguish it.

Now that we have the classes of fires in mind, let's go on to the basic types of fire extinguishers and the classes of fires for which they were designed. There are five basic types. Each major manufacturer has his own design. There are also variations within the type. The basic types are: (1) Carbon dioxide (CO_2); (2) dry chemical (dry powder); (3) water; (4) foam; (5) vaporizing liquid. In this article we will discuss the dry chemical extinguisher; the discussion of the others is planned for publication in other issues of Fire Control Notes.[1]

Dry chemical is a Class B and Class C extinguishing agent. It extinguishes a fire by cooling and smothering. The chemical is primarily sodium bicarbonate (baking soda) with a moisture inhibitor added to prevent caking and to permit free flow.

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[1] *Fire Extinguishers, Their Types and Use. I. Carbon Dioxide Extinguishers*, by A. B. Everts. Fire Control Notes 15(4): 1-5. 1954.

Actually, the dry chemical extinguisher is not new. It is only during the last few years, however, that it has gained the favorable acceptance it rightly deserves.

Many of us remember the old tube extinguishers, the kind you'd jerk off the wall (to remove the lid) and scatter the contents over a fire with a sweeping motion. The chemical in the tube was sodium bicarbonate. The inefficiency of these tube extinguishers was due to three reasons: (a) Usually there was no moisture inhibitor in the soda with the result that the chemical caked; (b) a sweeping motion of application would not produce a "cloud" as is possible with pressurized extinguishers: and (c) all too frequently the extinguishing agent was used on a Class A fire, for which it is not intended.

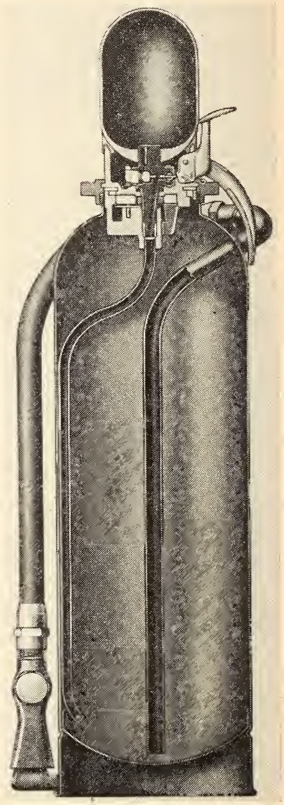

FIGURE 1.—Cutaway photograph of a modern dry chemical pressurized extinguisher. The CO_2 expelling cartridge is in the top. Other types carry the cartridge on the side, or inside the extinguisher shell.

The first CO_2 pressurized dry chemical extinguisher in the United States came on the market in 1928. It was the product of one company and certain patent rights prevented general manufacture until the patent expired. All the major extinguisher manufacturers now have their own designs and sizes.

How the extinguisher works.—Figure 1 is typical of the working parts of a modern dry chemical fire extinguisher. When the CO_2 gas in the oval cartridge is released, the gas is conveyed to the bottom of the cylinder through the tube shown on the left. This action tends to "fluff up" the chemical in the bottom of the cylinder and force it to the hose line through the center tube. Most nozzles have a squeeze operating lever which permits the application of the chemical intermittently or all at one time.

The great majority of the hand extinguishers are pressurized with CO_2 cartridges. A few of the smaller units are pressurized direct (without cartridges) with air or nitrogen. This type is provided with a pressure gage so that the pressure can be easily checked. Large 150- to 350-pound wheeled sizes usually use nitrogen for pressure (drier than CO_2). These types have hose lines and the nozzle is usually a horn similar to the kind used on CO_2 extinguishers.

Since only a small amount of CO_2 gas is used in expelling the chemical, it isn't necessary that the extinguisher shell withstand

excessive pressures as is the case with the CO_2 extinguisher. For this reason the dry chemical extinguisher is relatively light in weight per unit size. The large wheeled types, using cylinder nitrogen, are provided with pressure regulating valves.

How the chemical works on a fire.—The fine chemical is emitted in a cloud. Reach, or projection, is 8 to 12 feet in the hand sizes as compared to 6 to 8 feet for CO_2 extinguishers. The large wheeled types have a projection of from 20 to 25 feet.

The spectacular performance of dry chemical on a fire is due to three reactions:

SMOTHERING: The fine cloud of dust displaces the oxygen.

COOLING: The fine particles of chemical have the physical properties to rapidly absorb heat. The intensity of the fire is very rapidly decreased.

CHEMICAL: When exposed to sufficient heat, sodium bicarbonate will break down and release carbon dioxide and water vapor. This reaction takes place in the flame area. An exceedingly hot fire will bring about this chemical change simultaneously and much quicker than a fire of less intensity.

As mentioned earlier, dry chemical is essentially a Class B and Class C extinguisher. Its most spectacular performance will usually be on a Class B fire. The chemical is a nonconductor and is safe to use on Class C fires. However, certain types of Class C fires, such as a fire in an electric motor, may be more difficult to extinguish with dry chemical than with a vaporizing liquid extinguisher. The reason for this is the difficulty of getting the powder into the openings in the motor housing.

On Class A fires dry chemical is about as effective as CO_2. Deep seated fires can be knocked down and retarded but reignition can be expected. However, on certain types of Class A fires, such as lint fires in a textile mill, dry chemical has been found to be quite effective. The chemical settles over the lint and prevents flame spread.

It is on flammable liquid fires, however, that dry chemical "steals the show" per unit size. A series of approved tests, based on the number of square feet of fire area extinguished, proved that a 4-pound dry chemical extinguisher was more effective than a 2½-gallon foam extinguisher, a 20-pound dry chemical extinguisher outperformed a 100-pound wheeled carbon dioxide extinguisher, and a 30-pound dry chemical extinguisher was almost as effective as a 38-gallon wheeled foam unit.

Dry chemical is not as clean as CO_2. It leaves a residue of chemical in the fire area. Except for fires in vats of essential oils or in foodstuffs, this disadvantage is minor. It is not likely to be important in the class B fires with which we will be concerned.

Maintenance.—Maintenance of dry chemical extinguishers is no problem. If the expelling cartridge is intact, and the cylinder is full of chemical, the extinguisher is ready. In some models the cartridge is checked by weighing. Since CO_2 is the pressurizing medium, no freezing problems are encountered. The extinguisher is effective from —40° to 120° F. the same as CO_2.

If extra chemical and cartridges are on hand, the extinguisher can be recharged at field stations. On some fires only a blast or two of chemical may be used. To save the rest of the chemical, turn the extinguisher upside down and release the gas. More chemical can then be added and a new cartridge inserted. Used cartridges can be turned in for charged ones on an exchange basis.

Extinguisher sizes.—Like CO_2, the size of the dry chemical extinguisher indicates the weight of the chemical. Generally the total charged weight is about double the size classification in pounds, for the hand extinguishers. Prices vary somewhat between manufacturers, both for the extinguisher and for the chemical and cartridge replacements. The following list prices, therefore, are approximate only:

Size	*List price*	*Chemical Charge*	*Cartridge list price*	*Cartridge exchange*
5	$32.00	$ 2.00	....	....
10	55.00	2.50	$6.00	$2.50
20	67.50	4.75	6.00	2.50
30	82.00	11.50	6.50	2.50

How to use the extinguisher.—Carry the extinguisher to the fire area and set down (hose types). Aim the nozzle at the hottest part of the fire and release the gas. Usually a quick shot or two of the chemical will decrease the intensity of the fire, after which you can advance sweeping the nozzle back and forth across the face of the fire for greatest coverage.

Cautions.—There are no particular cautions in using a dry chemical extinguisher. It probably wouldn't be a good idea to discharge the chemical in a person's face.

Summary.—(a) Use on Class B and C fires, effective on some Class A surface fires; (b) light in weight in relation to its effectiveness; (c) can be serviced in the field; (d) will not freeze; (e) range 8 to 12 feet; (f) effective from —40° to 120° F.; (g) safe to use; (h) minor maintenance, trouble-free.

Dry chemical is sometimes referred to as dry powder or dry compound. Fire engineers, however, are attempting to standardize the term "dry chemical" as applying to an extinguishing agent for use on flammable liquid and electrical fires. The term "dry powder" on the other hand is meant to mean the powder type of agents used for specific hazards, such as certain metals.

AERIAL CARGO DROPPING STREAMERS

Homer W. Parks

District Ranger, Payette National Forest

The need for marking special fire cargo dropped from planes so it is easily and quickly recognized was clearly evident to the fire overhead who participated in the suppression of the Studebaker Saddle fire.

This fire was discovered August 11, 1952, at 2:25 p. m. in the steep walls of the rough, rugged "River-of-No-Return" just 4 miles west of the 7,000-acre Huntz Gulch blaze of 1949. It was started by a dry lightning storm at the base of Fall Creek Canyon in a blind area from all lookouts. Fire danger was extreme and this fire had spread to 10 acres in flash fuels before it was discovered. Plans were put into effect immediately to use a fast hard-hitting force to control this fire in the first burning period. This plan required special fire-fighting equipment to be delivered by air.

Eight trained and seasoned smokejumpers were equipped and loaded into a suitable plane piloted by experts at rough country flying and trained specifically for this type of work. At the same time the fire dispatcher in McCall requested from Missoula, Mont., 34 additional smokejumpers to be sent with experienced fire overhead to the fire. Experienced, trained fire fighters in trail crews, mining camps, and logging camps were started immediately to the fire from the Warren Ranger Station. The McCall jumpers bailed out on the top of the ridge above the fire and then their cargo was dropped to them. As the McCall plane was leaving for another load of cargo two C-47 planes roared over the high peaks from Missoula with the 34 fully equipped smokejumpers aboard.

By 6 p. m. 42 smokejumpers and 8 loggers and miners were on the fire and more than 100 individual cargoes had been dropped. These cargoes consisted of VHF radios, first-aid equipment, jumpers' gear, power chain saws, fire pumps, 4,000 feet of fire hose, gas and oil, camp equipment, beds, rations, and other supplies. Despite skilled dropping, more than half of the chutes hung up in dead snags and green timber on the steep slopes. There was a desperate need to get the cargo out of the snags and trees before the fire crowned over the drop spot area. The cargo was scattered over a quarter-mile radius because of the high up-slope winds at the time of the dropping. The problem which confronted us was locating the cargo bags that contained such items as one-man power saws, VHF radios, and first-aid equipment. Such items are always needed during the early stages of any project fire, while food and camp equipment may be retrieved after the suppression job is under way.

Valuable time was lost in locating the VHF radios because it was not possible to differentiate cargoes containing them from others. One badly needed power saw that could not be immediately

replaced on the fire was burned as a result of delayed discovery. An extended search was necessary to find gas and oil needed for power saws being operated on the fire.

First-aid equipment, including snake bite kits, was needed because of the many hazards that confronted us in night work on this type of fire. The hazards included a rattlesnake infested area, falling snags and trees, rolling rocks (the slope exceeded 70 percent), working at night with headlights and sharp handtools, a crowning fire caused by high winds, and difficult smokejumping conditions.

This 160-acre fire was controlled the first burning period by an 85-man crew and fortunately no lost time accidents occurred. However, the difficulty in quickly identifying special cargo led to the development of what we call the "streamer method." This streamer method was used on the Warren District during the 1953 season on two project fires—the Vaux fire, a Class E, and the Mosquito Creek fire, a Class C—with very good results. By using colored streamers, there were no delays in retrieving urgently needed cargoes.

It was found that streamers of different colors to identify certain cargo were confusing both in the warehouse and in the field. Warehousemen preferred using only red streamers. From tests made, the best type of streamer for this purpose was red cloth, 4 inches by 4 feet, with the cloth streamer tied directly to the top of the cargo. This red cloth is standard equipment in the warehouse and costs only a few cents per streamer. The streamers may later be used as line markers on the fireline.

Streamers were attached to the following types of cargo: (a) first-aid equipment (including snake bite kits, sedatives, and stretchers); (b) communication equipment (including VHF and SPF radios); (c) gas and oil for power saws and fire pumps; and (d) linesman's climbers, safety belts, rope, and camp commissary. Power saws and fire pumps that are dropped in red plywood containers with the name of the contents lettered on the sides of the package did not require streamers.

The maximum number of packages requiring red streamers was 5 on any one plane load containing 15 cargoes. The contents of these loads were 6 VHF radios, a 1-man chain saw, 10 gallons of gas, 6 quarts of oil, linesman's climbers, safety belt, 40 feet of ½-inch rope, two 25-man first-aid kits, 24 small first-aid kits, a dozen notebooks for fire overhead, camp commissary, and hard hats. When VHF radios were dropped, no more than two radios were placed in one package in case of chute failure.

The red streamers were clearly visible to ground crews immediately after the cargoes left the plane. No streamers were torn off when cargo was dropped through thick timber. No expensive equipment was lost on the two 1953 project fires, and the fire boss had a better check on all specialized fire equipment dropped.

The communication system on any project fire may be established within minutes by using the streamer system while hours are required if each package must be unpacked when streamers

are not used. When cargo chutes become hung up in snags and trees and the package is marked with a red streamer the package must be released by use of linesman's climbers, safety belt, and rope and lowered gently to the ground. This will avoid damaging expensive equipment such as the VHF radio. On fires where the number of cargoes is five or less or where special equipment is not used, streamers are unnecessary.

The red steamer aided materially in locating first-aid equipment (stretcher and sedatives) dropped for an accident in the 1953 season. No delay was experienced in giving the victim first-aid treatment to relieve severe shock and pain.

The streamer method is simple and seems foolproof. The Payette National Forest warehousemen favor this system for all project fires where cargo is dropped.

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A Safe Way to Fell a Burning Snag

The idea of burning snags down is not new but with the increasing difficulty of finding qualified fallers, the practice is becoming more important from a safety standpoint.

Snags that are too dangerous to saw down because of falling bark and limbs can oftentimes be burned down by throwing additional fuel such as limbs and small chunks around the base. The object is to increase the amount of heat at the base to speed burning. If the snag is partially rotten at the base, this increased heat will burn it down. If the snag has a solid heart, the limbs, bark, and rotten wood burn off, and the solid part can then be felled with a reasonable degree of safety.

The procedure is usually limited to night time or periods when danger of spotting and spreading is low. However, if the snag is already throwing sparks, the added heat may not increase the danger, and by speeding up the burning it is often possible to get the snag down or at least burn off the loose fuel before the wind increases.

Examples of situations where the procedure is practical:

1. One man or small crew makes initial attack on a lightning fire during the night or early morning. Fire is well established in snag and there is no chance of putting it out. By increasing fuel at the base, snag will either burn down or limbs and top will burn off so it will be safe to fell before the heat of the day.

2. Large fire controlled at night by direct attack or backfiring. Burning snags along the line will cause fire to spot across the line when the wind comes up if they are not felled.

Night crews can contribute to the mopup job by burning as much fuel as possible inside the line. Pile limbs and small logs against large logs and at the base of snags.

Safety measures.—Personnel must always be alert to the possibility of falling limbs or the tops burning off. Fuel can be thrown from some distance away, but "widow makers" can bounce 20 feet or more. Keep "heads up" whenever in the vicinity. It is easy to throw the fuel and still keep an eye on the upper part of the snag.

Fire burning hot from the base normally burns off lower limbs first, thereby reducing the danger of falling limbs bouncing from limbs below.

If the snag has no pronounced lean and direction of fall cannot be ascertained, pile on the fuel and then keep all personnel far enough away to be in the clear while the snag burns down.—R. W. ASPLUND, *Fire Control Officer, Plumas National Forest.*

RETAINER CLIP FOR TROMBONE PUMPS

MERLE ALDRICH

Fire Officer, Michigan Department of Conservation

Many refinements which contribute to efficient action in fire control are simple devices that promote orderliness and neatness in handling and storing various tools or apparatus. Examples are legion and may be observed at any modern equipment depot. Most of them have been developed by fire officers themselves, and in too many instances have remained obscure because information about them has not been published nor disseminated for use by other agencies.

One such device was developed in Osceola County of the Baldwin District of the Michigan Department of Conservation. Figure 1 shows the application fully and reduces necessary explanation to a minimum. The device has been simply called a retainer clip for trombone pumps. Fire officers accustomed to the use of slide action pumps have all been troubled with their tendency to open up to the full extent of the telescoping tubes, and become liable to damage; at the very least the condition defeats good usage of the pumps, and disorder in storage or transport usually results. The situation becomes troublesome when pump cans are transported on rough roads and vibration causes pumps to become extended.

As shown, clips may be manufactured from curved stiff wire, and the only tool required is a pair of pliers. The loose ends are joined by a wire splicing sleeve, thus eliminating welding, soldering, and twisting.

Based on experience to date, the best material for manufacturing the clip is standard copperweld wire with a steel core. The natural curve of the wire as it comes from the roll, gives the proper spring effect when the prongs are bent at 90 degrees to the curve of the wire. Made in this way the clip has adequate strength to hold the pump parts firmly in retracted position, and yet the spring action is sufficiently soft to permit quick removal from the pump handle. When detached from the pump, the clip is sufficiently compact to permit being carried in a coat pocket, or it may be slipped beneath a belt with the prongs pointing outward.

The clips are kept on the pumps while in storage or transport, and may be readily removed when they are to be put to use. Since manufacture is very simple, supplies of clips can be made up as time permits.

In the Baldwin district where the clip was developed, it has been successfully used since 1948 and fire officers attest to its convenience and usefulness. By preference of individual fire fighters,

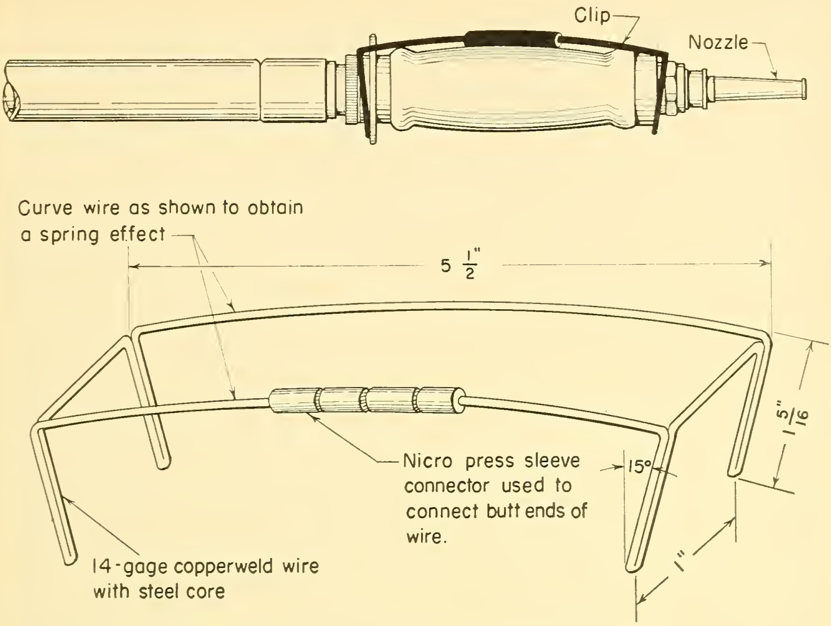

FIGURE 1.—Retainer clip for trombone pumps.

trombone pumps are widely used. As far as storage, transport, and application are concerned, their tendency to become extended and awkward to handle has been the major objection to them. The retainer clip corrects this fault completely, and it requires no conversion or additions to the commercial pump assembly as furnished by manufacturers.

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"How Forest Fires Get Started in Cumberland and Morgan Counties, Tennessee," is the title of an attractive and stimulating report recently published by the Tennessee Department of Conservation and the Tennessee Valley Authority. It is a searching analysis of fire cause in a high-incidence, two-county area of the Cumberland Plateau. Methods used, facts revealed, and conclusions reached are described in detail. A limited number of copies are available; those interested may obtain copies by writing either of the publishing agencies.

TRACTOR-PLOWS VS. 60 MILES OF INCENDIARISM

JOHN W. COOPER

Assistant Forest Supervisor, Mississippi National Forests

How would you like always to have crack 22-man fire suppression crews available, never tired, ready to go in 30 seconds, and without any payroll to make?

This analogy is based on statistical analysis of production rates of firelines in the Coastal Plains section of the Southeast by handtool crews compared to rates of production by the light 18-25 horsepower crawler tractor and Ranger Pal plow. These analyses covering several thousands of fires have shown that these light plow units teamed up with 3-man crews can build and hold as much fireline per hour as a 25-man handtool crew. As a matter of fact, the quality of the line built by these plow units, hauled by 1½- to 2-ton trucks, is far superior to the line a 25-man crew could build. On the higher class danger days, a high-quality line completely cleared becomes more important. On these higher fire danger days, the handtool crew is generally run over by the head of the fast moving fires in the flashy fuels of the Southeast so that the statistics for such days actually belie the potential of hand crew production.

An outstanding example of the speed and effectiveness of the Ranger Pal plow units can be cited by a description of suppression action on the Leaf River-Black Creek Districts, Mississippi National Forests, on January 24, 1953. On that date, four inebriated young men strung out an estimated 1,000 sets of fire along a total of 60 miles of road in 2 hours and 17 minutes. Wind velocity was 20 miles per hour and fuel moisture down to 5 percent. All sets were made on the leeward side of the road so as to take full advantage of the high winds. The route of travel was carefully planned and was, in general, at right angles to the wind direction insofar as available travel routes would permit.

These series of sets were all controlled in exactly 10½ hours from time of discovery of the first set. The majority of the sets burned together and control was affected around 17 different fire areas. The same district fire organization had to suppress 3 additional incendiary fires covering 108 acres set by other parties off the "60-mile route" during this epic afternoon.

In a country where a spread of 5,000 acres in 4 hours is not uncommon, the suppression of this series of sets with a loss of only 3,637 acres is nothing short of phenomenal.

The present Leaf River and Black Creek Districts were administered as one district prior to 1950. They embrace a total protection area of 356,624 acres. When the two districts were set up in

1950, a decision was made to continue handling the fire organization as a single unit under one dispatcher. A Memorandum of Understanding was drawn up between the two rangers and approved by the supervisor authorizing the dispatcher to assign crews and equipment without regard to district boundaries. First line defense on these districts is primarily by the light crawler tractor and Ranger Pal plow with 3-man crews. A total of 9 Ranger Pal units, one heavy disk type fireline plow with medium-sized crawler tractor, and one 1-ton, 4-wheel-drive truck with 200 gallon tanker made up the list of mechanical equipment assigned these districts.

From Weather Bureau reports and local observations, the dispatcher had predicted a Class 4 fire danger day for Saturday, January 24, 1953. On the basis of this prediction, only 6 plow units were manned prior to the discovery of the first of the series of sets. When this holocaust began, crew foremen for the four unmanned plow units and tanker were contacted by messenger at their homes within a radius of 10 miles. Each of the foremen picked up his helpers and all plow units and the tanker were fully manned within 1 hour of discovery time. It is estimated that at least 3 or 4 hours would have been required to recruit enough hand labor to have been equivalent to the production potential of these four plow units, and even then, it is doubtful if any number of men could have held a line across the head of these fast moving fires. It is further estimated that if there had been 4 less plow units available that the burned acreage would have been at least 25,000 acres instead of 3,637.

The first in the series of sets was discovered at 1:00 p.m. with the peak of the burning day still ahead. Attack on this first series of sets was made by two Ranger Pal units 12 minutes after discovery and these sets were brought under control exactly 2 hours later at 170 acres. The final control line was closed around the last of the series of sets at 11:30 p.m.

Seven minutes after discovery of the sixth series of fires, an eleventh plow unit was enroute from the Biloxi Ranger District 44 miles away. Two hours later this unit was in action on the line. On discovery of three additional sets, the second Biloxi District plow unit was called and 2½ hours later it was in action. This latter unit was a heavier and slower type.

A thirteenth plow unit was called from the Chickasawhay District 31 miles away at 2:30 p.m., but its departure was delayed 1½ hours because of going fires on that district. Two handtool crews of 4 men each were recruited to catch first line mopup to relieve plow units for line construction. The entire control organization may be described as 13 tractor plow units and 1 tanker and a total of 51 men. Total perimeter of all fires controlled by this organization in 10½ hours added up to 67 miles.

Suppression technique under such adverse conditions was advisedly modified to a limited extent. The crews wisely bypassed three of the earlier sets which were heading into the jams of wide creeks in order to cut off the head and flanks of other sets where

no help from natural firebreaks could be expected and heavy losses were imminent. The crews correctly hit heads of the most potentially dangerous sets, cutting the head and flanks off, and in a number of instances leaving the back of the fire burning until the heads of other dangerous sets could be controlled. Since it was prescribed burning season, leaving the backs of some of the fires was equivalent to a good prescribe burn, whereas the heads of the fires were rolling through the tops of the trees 50 and 60 feet high and causing considerable mortality.

Wind velocity was sufficient to cause the head fires to jump a 100 foot highway right-of-way. Therefore, for the information of anyone not familiar with plow operation, it should be pointed out that we do not expect the plowed line to hold the fire, but merely to serve as a place from which backfire can be set. The plow lines usually hold the backfire when assisted by a safety man with a back-pack pump or a tanker unit, particularly on the flanks and back, but trouble is frequently encountered with breakovers across the head. With high winds, it is advisable to use two plows, the second plowing a line fairly close outside of the first line across the head after which the plows can be split to take the opposite flanks as individual units. When two plows are not available to throw across the head on high windy days, it pays to move out far enough ahead to permit the single plow unit to double back across the head before starting backfire. Of course, the plow unit should be held on the head and not allowed to start down the flanks until the backfire and head have burned together.

Oh yes, what about law enforcement? We got on that, too, with a couple of men and at the time of this report the culprits were awaiting trial in Federal Court under $5,000 bond each.

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Pumps Uncoupled from Back-Pack Cans in Truck Toolboxes

The clip on the back-pack tank frequently does not hold the pump securely. If the pump is made secure by a strap, the inner plunger often slides out, becomes dirty or bent and sometimes broken. A simple coupling was therefore designed so that the pump can be detached and carried inside the fire toolbox. The length of hose left on the tank should be made long enough so it can be carried in the same clips that held the pump. (The clips will have to be bent slightly closer to hold the hose.) The same end of the connector should always be used with either the pump or the tank, preferably the male end of the connection on the tank. This allows free interchange of tanks and pumps, and the gasket which is in the pump section is not so apt to be lost as it will be carried inside the box.—H. W. JANELLE, *District Ranger, Alabama National Forests.*

PREVENTION PAYS OFF ON THE TOIYABE

LYLE F. SMITH

District Ranger, Toiyabe National Forest

The Alpine District of the Toiyabe National Forest embraces some 343,000 acres within its protection boundaries within the Carson River Drainage in California and Nevada. More than 28,000 acres is in private ownership.

The major uses on the district are grazing, recreation, and timber harvesting. In 1953, more than 12,000 head of sheep and 5,000 head of cattle grazed on all lands on the Carson Watershed within the Forest boundary. In addition, approximately 30,000 people spent nearly 150,000 days' visits to enjoy the recreation facilities in the area, and approximately 8 million feet of timber was harvested by 6 timber operations.

The normal population within the area (Alpine County is one of California's smallest in population) is about 600; this is swelled to 50 times as many during the summer months by forest users. Four transcontinental highways traverse the district over mountain passes into central California.

Up until the past 10 years, the "East Side" Sierra region was considered as "asbestos," that is, it wouldn't burn. As other thinly populated and little used areas in the West have witnessed, an influx of population and users has brought about an ever increasing risk of fire. This, coupled with an invasion of "bronco" and other undesirable annual grasses, has increased the hazards of fire. The fuel is flashy and has a high rate of spread and a high resistance to control.

Up to 10 years ago, the protection agencies merely put out what few fires occurred without any questions asked. "It was part of the job and a contribution-return to the taxpayers." Organizations were small, prevention was almost unheard of, and enforcement rare.

About 1940, Ranger Robert Gardner was assigned to the Alpine District. Fire occurrence on this district was increasing to an accelerated degree in the period following 1940. Protection forces, prevention, and enforcement had not kept pace with the load. The 1947 season was almost disastrous. Almost 16,000 acres were destroyed that year by a series of man-caused preventable fires, a total burn of more than 5 percent of the area under protection. Residents were just as careless as recreationists. Within a period of 5 years, more than 10 percent of the district had been burned off. Residents and users, as well as Forest personnel, were alarmed. The day dawned with the realization that the "asbestos" would burn. Presuppression forces were maintained at the same levels and there was little outlook for additional presuppression assistance.

Ranger Gardner started a reorganization of the protection forces at his command. The people of Alpine County clamored for better protection. Gardner dove-tailed his reorganization of forces with demands of the people into the small but significant

word COOPERATION. The County purchased an $8,000 pumper and housed it at Woodfords, in the center of the hot spot. Volunteer firemen were organized and trained in forest and range fires as well as structural fires. The County purchased 2 pumpers for use by the Forest Service. Within the Forest organization studies were made that resulted in the closing of the only lookout on the district because of its ineffectiveness in detection. The operator was added to the fire crew as a "prevention patrolman" to contact the residents and users. California State fire laws were, as a whole, adequate but had some loopholes. The loopholes were plugged by the passing of County ordinances.

The results? Here are the results for the year 1953 which was considered "bad" on the district from a burning condition as well as a record standpoint: Total number of fires, 21; total area burned, 272 acres (eight-tenths of 1 percent of area under protection) ; total man-caused fires, 7 (1 by tourists or recreationists, 6 by residents and forest industries) ; total area of man-caused fires, 267 acres (1 fire burned 260 acres) ; number of fire trespass civil cases settled or pending, 4; number of fire prevention law enforcement criminal cases settled, 13.

The campfire permit that is required in the State of California provides an opportunity to make a prevention contact. We have placed the fire permits in strategically located business houses throughout the County. The issuing agents are instructed to give a personally delivered short fire prevention message with each permit. This is helpful to tourists receiving the permit as well as serving as a reminder to the business resident. We find only a few fires occurring from permit holders within our County.

The prevention patrolman has regularly scheduled routes of travel on the district at times to meet the greatest number of people, i.e., Saturdays and Sundays late in the morning to early evening. During his travels, he only averages about 10 miles per hour. He is given "salesmanship" training to enable him to meet the public in the most friendly manner.

In camping areas the patrolman uses the fire permit as a means of meeting the people. To those with permits, he never fails to leave a short prevention message. To those who have failed to obtain a permit (through ignorance) he issues the permit with a little longer message. The repetition of contacts acts as a continual reminder. We have yet to receive a complaint from anyone who has been bothered or inconvenienced by these repeated contacts.

Fishermen and hunters along the streams and roads are given an informal short prevention "chat" when visited. Local residents are given the same treatment, as well as a hazard reduction survey of their property.

During his patrol, the prevention man sees that people are camping on the safest possible areas. Campground facilities are not adequate on the district to confine all the campers within the improved camping areas. "No Camping" areas are posted whenever possible. A short, friendly discussion usually results in people moving from dangerous locations to safer areas. A per-

sonal safety approach on these problems brings results. We often even help them pack and relocate.

When violations occur, such as failure to extinguish a campfire before leaving, smoking in dangerous area, etc., the citation law of California is used. A "Notice To Appear" form is filled out which states the violation and the date and time the violator is to appear in the Justice Court. When the violator acknowledges the form by signing it, he promises to appear. Failure to do so can result in a bench warrant being issued for his arrest.

When the violator is not present at the time of discovery, the citation is left with instructions to appear at the guard station. Any and all identification is noted on the citation to make it known that we know who the violator is. At no time does the patrolman make an arrest or indicate he is making an arrest.

When the violator appears at the station, the ranger or assistant ranger discusses with him his violation and fire prevention.

By talking with the ranger, the violator usually realizes his mistake and is willing to make amends. If the violation is minor, we usually let the incident serve as a reminder; however, if the violation is of a major nature or the attitude of the violator too complacent, we issue another notice to appear and make arrangements for a quick hearing in the Justice Court.

The ranger or assistant ranger always attends these Justice Court hearings with the prevention patrolman in presenting the evidence. Previous and continual contacts with the local Justice of the Peace results in a complete understanding of the necessity of fire prevention.

The results of the Justice Court hearings are always given notice in the local newspapers. The published result of a tourist's violation is usually not seen by the tourist because of the limited distribution of the local paper, but the local residents who read the local papers are kept aware. When residents are violators, the results are rather embarrassing, but as yet no animosity has resulted, and usually more respect has been obtained.

It is difficult to gather vital evidence during an initial attack on a going fire when the primary job is to get the fire under control. We attempt to contact each person at the scene of the fire and arrange a later time or date to secure their statements. This is done after the fire is controlled, either at the scene of the fire, their locations, or at the fire station. The discussion is made individually and not as a group. The person is encouraged to talk as much as possible at the interview, the pertinent facts are obtained and analyzed, and action is taken. The local law enforcement officers are most cooperative in helping us interview the people involved, to speed up the process while the impressions are still vivid in the minds of the people. Too often delay causes forgetfulness and omissions of pertinent facts.

Our first objective in fire cases is to attempt to secure suppression and damage costs to relieve the taxpayer of the burden of paying for other people's mistakes. Our second objective is to bring the violator to justice. Depending on the nature or degree of the case, civil or criminal action or a combination of both may be used.

BILGE HAND PUMP FOR FILLING BACK-PACK PUMP CANS

ANNE C. ALLEN HOLST[1]

Chief, Forest Fire Experiment Station, Cedar Hill Fire Department, Cowesett, Rhode Island

Most fire departments now have a tanker-truck to augment their back-pack pump men in forest fire control work. While these tanker-trucks, in nearly every instance, must stick to roads and trails, the back-pack pump men can range deep into the fire area, whether it be steep hillsides, across a swamp, or in the deep woods. The practice of having to return to the tanker-truck, or to tie up a hose line from the tanker, to refill these back-pack pump cans is almost universally practiced.

This returning to the tanker-truck, which is operating with its hose lines as a separate unit in an area possibly quite a distance from where the pump-can man is working, is a costly procedure from many standpoints. Too often, a small source of water is available in the area where the pump-can man is working, but no handy method of filling his or his fellow operators' pump-can tanks is available. The tying-up of a portable power pump at such a small water source simply to refill pump cans is not good strategy. What is an efficient solution?

Of course, there is always the collapsible pail—but water sloshed from a pail is an awkward way of filling the pump can during the stress of a fire. More water goes on the ground than into the pump can in many instances. And the dripping can is unpleasantly wet when placed on the wearer's back. A decidedly better solution is the simple matter of adapting a marine hand bilge pump for filling pump cans through a rubber hose.

There are many models, both inexpensive and expensive, and of varying capacities, on the market. They range in price from a high of around $40 for an all-brass, large-capacity bilge pump, down to $3.95 for an inexpensive galvanized steel bilge pump of 10 gallons per minute capacity.

The true measure of a hand pump's capacity is the number of strokes per gallon. The largest pump, mentioned above, weighs 15 pounds, and has a capacity of 3 strokes to the gallon. While the large capacity is desirable, the pump's weight precludes its use for

[1] C. F. Ritter's article on handtools in the January 1954 issue of FIRE CONTROL NOTES, points up the fact that despite the flood of machinery designed or adapted for forest fire control work hand-powered tools are still needed for efficient control. This article has been written to call attention to another hand-powered tool not now associated with forest fire control work, but whose possibilities seem good as an effective aid in forest fire control.

forest fire control work. A single-action brass bilge pump, weighing but 1⅝ pounds, with a capacity of 4 strokes to the quart, and costing $5.40, would be more practical. More expensive, and weighing considerably more (7¼ pounds), is a brass double-action bilge pump with suction hose, strainer, and discharge hose, selling for $15.90 and having a capacity of 3 strokes to the quart.

All bilge pumps, if they do not already come equipped with a strainer, should be fitted with a strainer of reasonably fine mesh to keep dirt out of the pump cans. A carrying strap can be rigged so that ease of transportation is assured.

No "best" pump has been selected from the many tested, as too many factors enter into the conditions governing the use of bilge pumps for forest fire control work in different areas. All are good pumps, however, and are readily obtainable from commercial boat supply houses.

Bilge pumps come in two styles: Those resembling a hand tire pump, with a foot hold to steady the pump on the ground while pumping through a suction hose; and those without a suction hose, which are simply operated by having the open end of the pump barrel stuck into the water source and the pump held in the hand while pumping.

Bilge pumps will operate in smaller sources of water, and in shallower water, than most any other type of pump, power or manually operated. This should be a big selling factor for bilge pumps for forest fire control work.

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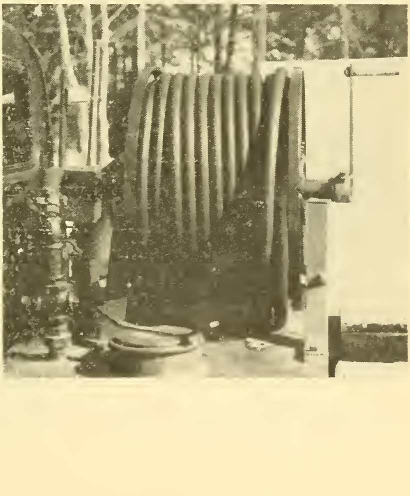
Crank for Live Hose Reel

A crank for winding hose on a live hose reel was made as follows: a 1½-inch driving cap, dressed round, was screwed on to the axle of the reel. The crank was made from a section of ¾-inch pipe around a bolt handle secured to a 1- by ⅜-inch strap iron. This bar, of proper length to safely clear fire toolboxes or other objects, was then welded to a section of pipe union which was secured to the driving cap by set screws.

This crank, which can be made from various salvage materials, permits one man to reel up the hose with ease and guide it for level winding.—WILBUR R. ISAACSON, *District Ranger, Chippewa National Forest.*



PORTABLE HOMEMADE HAND PUMPER

H. W. Janelle

District Ranger, Alabama National Forests

About a year and a half ago we made an analysis of the fires occurring on the Talladega Ranger District. One thing this study showed was that 2 out of every 3 fires on the district were either started or stopped on a highway, road, or woods road that could be traveled by a truck. Another point we determined was that a large number of these fires were discovered while still very small, usually roadside sets. It was obvious that if we could get water to these fires quickly we could accomplish two things: (1) Cut down on the acreage by catching them small; and (2) cut down on the costs by reducing mopup time through use of water. A slip-on pumper unit seemed to be the answer, but the cost of such a unit was so high that, in our case at least, it was doubtful we could justify the expenditure. Therefore, we decided to make up an economical little "pumper unit."

The unit consists of a 55-gallon drum mounted on a frame in a horizontal position with the filler hole up (fig. 1). A regular hose faucet is screwed into the small opening of the drum, a length

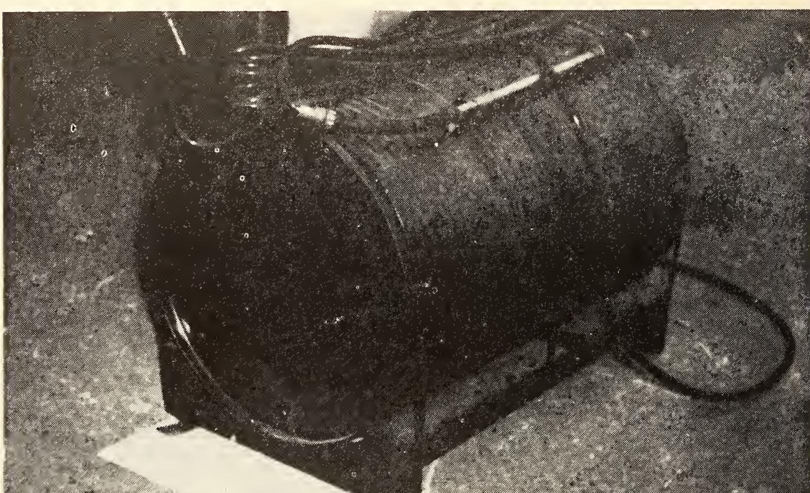


Figure 1.—Front view of homemade pumper unit, showing the two iron fasteners that slip into the truck seat brackets and secure the unit to the bed. Clamps that hold the pump are also visible. The hose is wound around two supports welded to each end of the tank. Note the garden-hose coupling that serves to fasten the pump to the hose.

of garden hose fastened to the faucet, and the pump from an Indian back-pack pump attached to the outlet end of the hose. This unit has been used with 100 feet of hose, and is capable of emptying the water when the nozzle is 25 feet higher than the drum.

It can be mounted in the bed of a pickup, the back of a jeep or, as in our case, a station wagon after removing the double seat in the back. Two pieces of angle iron are bolted to the frame supporting the drum so that the unit can be slid into the bed of the station wagon, using the same brackets that held the seat in place. One large wingnut secures the back end of the unit to a bolt set in the bed of the station wagon. It requires no more than 20 to 30 seconds to install or remove the unit; only the one wingnut needs to be tightened or loosened.

The unit proved very effective on small roadside fires which we were able to reach in a hurry because the light vehicle is much faster than a heavy truck or plow unit. We have also used it on mopup; and it is surprising how far the 50 gallons of water will go when applied with the back-pack pump. Although this unit has its limitations, it has proved effective for both control and mopup on roadside fires. It has more than paid for itself in a few weeks of this first fire season.

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Accessible Compartment for Pack Box

A constant source of irritation on a pack trip is having to carry lunches, binoculars, sign plan, camera, and the many other little things necessary for district administration on your saddle horse or else unpack your pack horse for every little need. This can be partially solved by building on the end of the pack box a small compartment that is accessible while the box is on the horse. This compartment can be constructed in a standard pack box that fits inside the regulation canvas pannier by adding a partition about 6 inches from the forward end. The canvas cover of the pannier will protect the compartment from debris or rain and can easily be raised to permit access. The diamond hitch or other lashing on the top pack doesn't prevent access if the rope is slid closer to the horse. This still maintains a good tight pack. The remainder of the pack box can be enclosed by a plywood lid that prevents rodents and other prowlers from raiding your supplies. Further information can be obtained from the author.—JOHN W. DEINEMA, *District Ranger, Teton National Forest.*

FIRE HOSE VULCANIZING PROCESS

William H. Larson

Chief Fire Warden, Washington Forest Fire Association

For some years it has been apparent that there is considerable waste in the necessary practice of severing and recoupling or discarding cotton rubber-lined forest fire hose each time a hole appears. Because of our interest in this problem, we obtained a copy of Forest Research Misc. Pub. 1, "The Wright Hose Vulcanizer," plus blueprints, from the Canadian Department of Resources and Development. This publication dealt with the repair of 1½-inch unlined linen hose, but we adapted the process to the repair of cotton-jacket, rubber-lined hose.

Only hose that is nonserviceable because of mechanically injured spots should be repaired. To this end, the injury should be clamped off and the remainder of the hose tested for strength and serviceability. Hose injuries should be divided into 2 groups: Those with holes under ½-inch in length and those with holes more than ½-inch in length. The former can be repaired by the process described here, but the latter must be cut and spliced. This is because there must be an area of hose fabric around the injury large enough for the necessary strength to develop in the adhesion of the patch.

Patches can be cured on any vulcanizing machine with flat plates 3 inches square or larger, one of which can maintain a constant temperature of 300° F. while the other is unheated. If it is impossible to cut the heat off one plate, a piece of insulating material can be used. Additional tools needed are a stitcher wheel, a sharp knife, a small toothbrush, and a ¾-inch paintbrush with bristles cut short for added stiffness.

Materials required are as follows: Rubber nail-hole patches (rayon reinforced); black cushion rubber, 1/32-inch gage (plastic backed); black rubber cement; cleaning solvent for rubber; and tire talc powder in small oilcan with spout.

Patches are made in the following manner:

1. Thoroughly clean with solvent and toothbrush the hose fabric of the area to be patched. It is handy to keep the solvent in an oilcan with small-diameter spout for this.

2. With sharp knife, trim the radial threads (woof) from the injury so that stray threads will not be found in the completed patch; they would act as a water passage. These radial threads are the principal load-bearing members, so the hole should not be lengthened by cutting more of them than are injured. In any event, the patch will not support an injury that is more than a half inch in length.

3. Grasp the hose in a manner to keep it rounded. Insert the spout of the talc can in hole and liberally coat bottom of hose with talc. Make sure the powder does not touch the top half of the hose around the hole; it would prevent adhesion of the inner patch.

4. Still holding hose so talc does not touch the top, lay a 1-inch square piece of cushion rubber, plastic backing down, over the hole and coat the top of the patch with cement.

5. Using toothbrush handle, immediately push the patch through the hole all the way to the bottom of the hose on the line of the diameter of the hose. This requires some care to prevent poking a hole in the rubber.

6. The patch will stick loosely to the toothbrush handle, resembling a folded umbrella sitting on the bottom of the hose (fig. 1). Press the top of the hose down against the upturned points of the patch and alternately release the pressure, sliding the hose up and down the brush handle as though opening and closing the umbrella, until the patch is flat. While flattening the patch, keep the brush handle against the bottom of the hose to keep the patch from dropping off and away from the center of the hole. Do not touch the top half of the hose to the talc-covered bottom until the patch is flattened. When the patch is flat, stick it firmly to the under side of the hole by pressing the hose together. The plastic backing stiffens the rubber patch enough to perform the above maneuvers, and it does not interfere with vulcanizing. Hereafter, keep the hose reasonably level so that the talc does not run away from area to be patched; the talc keeps the hose from sticking together.

7. Apply two liberal coats of cement to the hose fabric on an area the size of the patch, allowing each to dry in turn.

8. Apply a third coat of cement, and when tacky remove the plastic backing from a patch and press onto the fabric. Rub with a stitcher.

9. Place a piece of muslin over the bottom hotplate, or dust with talc, and press the patch firmly in the vulcanizer.

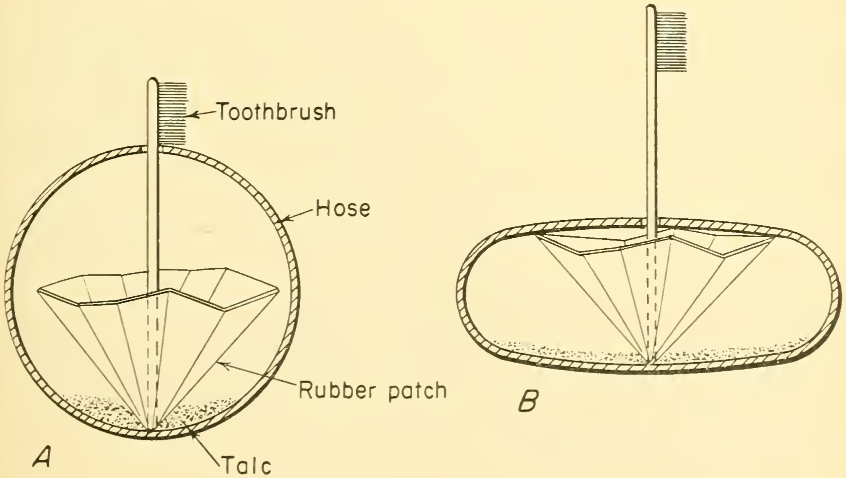

FIGURE 1.—*A*, Toothbrush handle in proper position to apply patch; *B*, hose alternately pressed and released only to upturned points of patch until patch is flattened.

10. Cure at 300° F. for 35 minutes.

11. Remove and grasp the flattened edges of the hose immediately. Squeeze them together sharply to pop the hose open. Allow the patch to cool 24 hours or longer before it carries a load.

The above method produces a patch of satisfactory physical characteristics, which does not weep. A few practice trials should be made on short lengths of hose to master the technique of placing the inner patch.

The patches we produced reacted to loads applied with fire-fighting pumps as follows:

Pressure (pounds)	*Pressure applied (hours)*	*Result*
350	1½	1 burst
350	1¾	Do.
350	2	Undamaged
160	3½	Do.
150	1¼	Do.
250	1	Do.
300	1	Do.
350	¼	Do.

Bursts originated in center of patch and ruptured 3½ inches of the fabric, lengthwise, showing that the hose-fabric tension was near its maximum strength.

Splices are applied in an entirely different manner, and a modification of the commercial vulcanizer is required. The Wright vulcanizer consists of a top and bottom plate, with heating elements and thermostatic control device. The plates are squeezed together by a screw and handle, and follow guides. Side pressure is exerted by two horizontal blocks, unheated, operating on slides with a screw attachment (fig. 2, *A*). Though not tried by us, it

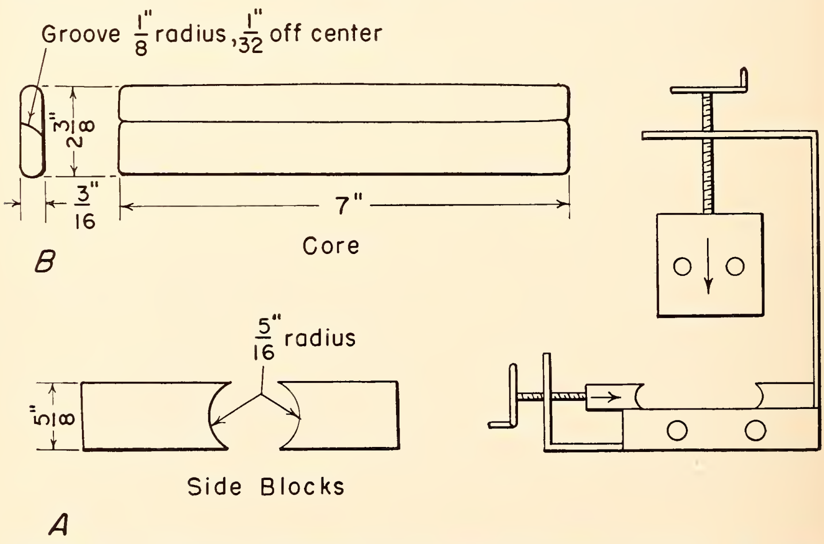

FIGURE 2.—*A*, Block arrangement of Wright-process vulcanizer; *B*, steel core used in Wright hose vulcanizer.

would seem that a commercial vulcanizer with plates 5 by 3½ inches, capable of maintaining 300° F. top and bottom, could be adapted by welding the side blocks to a "C" clamp or "Vise-Grip Welders Pliers."

It is necessary to insert a steel core into the hose at point of join. The steel core was cleverly designed for the Wright hose vulcanizer (fig. 2, *B*). The off-center placement of the radius center of the complementary curvatures allows the core segments to be easily removed by merely squeezing the edges in a vise to collapse them.

Materials for the splice: Tire talc powder; black cushion rubber, 1/32-inch gage (plastic-backed); rubber cement;[1] and 18-ounce hardlaid cotton duck saturated with rubber cement.[2]

Technique of splicing (fig. 3) is as follows:

1. Cut injured spot from hose, leaving a clean vertical cut on each end.
2. Clean hose fabric and rubber liner with solvent.
3. Apply 4 coats rubber cement about 2½ inches wide on each severed end of the hose fabric. Allow each coat to dry.

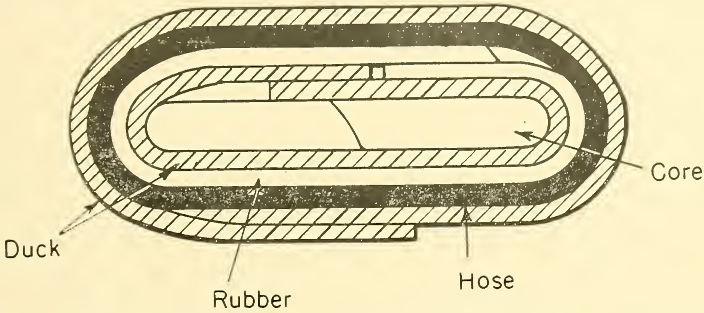

FIGURE 3.—Arrangement of hose and steel core in splicing cotton-jacket, rubber-lined fire hose.

4. Powder steel core with talc. While assembling splicing materials, care must be taken to minimize the amount of this talc rubbed onto the rubber materials.
5. Lay the core segments together and wrap a piece of impregnated duck 2½ by 6 inches around them. Cement the lap and stitch down. Arrange to have the lap on a flat side near one edge of the core.
6. Cement the duck—wait until tacky—and, starting at the edge of the lap of the duck, wrap with a piece of cushion rubber with backing removed (1½ by 5 inches). Stretch slightly so it laps on itself on the flat side of the cores. Stitch to the fabric. A

[1] An accelerator is required in either the cement or cushion rubber for curing. Since only one layer of this rubber is put inside the hose, a cement can be used that contains the accelerator. This cement is a specialty item not generally used by tire vulcanizers. It may also be used with the patches.

[2] This can be made for the job by repeated coats of rubber cement containing an accelerator applied to the duck. Allow each coat to dry, and repeat coatings on each side until the cement no longer soaks into the fiber.

double lap of either fabric or rubber on the edges of the cores will make it difficult to fit the cores inside the hose because of the width.

7. Apply cement liberally to inside of each severed end of the rubber hose lining and to the outside of rubber on the steel cores. Working rapidly while cement is wet, collapse the core segments to allow slack and slip them with the assembled rubber and fabric half way into one end of hose. Shove the other hose end over the assembly until both ends meet over the center of the rubber assembly on the cores.

8. Flatten the core segments—they should be a snug fit inside the hose—and press the hose to the inside assembly with the stitcher.

9. If the two hose ends have parted slightly in this process, fill the groove with layers of narrow strips of cushion rubber, each layer stitched in.

10. Cement the hose jacket again, and when tacky wrap with a piece of impregnated duck 4 by 7 inches with the lap on the opposite side of the cores from the inner laps.

11. Cover with a single layer of muslin, or powder plates with talc, and place in vulcanizing machine, screwing all plates tight. Cure for 30 minutes at 300° F.

12. Remove from machine and peel off muslin immediately.

13. While still hot, place in vise and squeeze edgewise to collapse the core segments; flake them out of the hose.

14. Wait at least 24 hours before applying a load.

Splices, made as described, successfully withstood the following tests with fire-fighting pumps: 3½ hours, at 160 pounds pressure; 1¼ hours, at 150 pounds; 1 hour, at 250 pounds; 1 hour, at 300 pounds; and ¼ hour, at 350 pounds. During the tests, the spliced hose were periodically flexed into circles of 10-inch radius while under load. The tests ended at 350 pounds pressure, because the couplings began to come loose from the hose owing to the repeated flexings.

Despite its stiff appearance, the splice distends into a circle at less than a hundred pounds pressure, and will offer no hindrance to rolling if placed in the outer half of the roll.

Although the processes described here gave satisfactory results, this should be considered an interim report. Certain refinements, and the need to extend the process to other types of hose, are evident. Some of these needs and refinements are:

1. A semicured vulcanizing sheet stock with flexible rubber and a light synthetic fabric of about 500 p. s. i. burst strength is needed. (It may be possible to make patches of this which would hold larger holes, and splices would be stronger and more flexible.)

2. This process has been applied to standard 1½-inch cotton rubber-lined forest fire hose only. The process in the abovementioned Canadian publication applies to unlined linen hose. The process should be extended to the new lightweight hose with very thin rubber linings and synthetic fibers in the jacket. The imponderables here are amount and duration of heat the lining and

jacket will stand without weakening, and adhesive quanties of the vulcanizing stock to the part-synthetic fiber.

It is hoped that this paper will stimulate interest in further research on this problem by other individuals and agencies.

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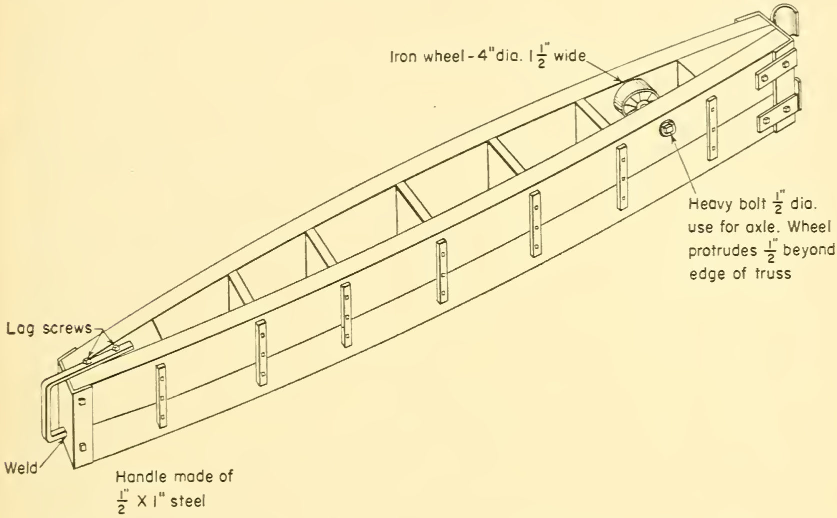
Safer Loading Truss

The loading truss shown in the accompanying sketch has been modified by the addition of the steel handle, and the small wheel mounted within the truss.



The addition of these minor improvements has made the trusses much safer to handle. The handle provides a good gripping surface for pulling the truss off the back of a truck, and the wheel permits the truss to roll easily on and off the bed when a slight lift is exerted on the handle.—*Lower Michigan National Forest.*

SUMMER BURNS FOR HARDWOOD CONTROL IN LOBLOLLY PINE

R. J. Riebold

Forest Supervisor, South Carolina National Forests

The occurrence of hardwood understories in loblolly pine stands on the Atlantic Coastal Plain and their relation to the regeneration of loblolly pine has been discussed by Chaiken.[1] He described the usual condition as follows:

"This condition is illustrated in a stand now under observation at the Santee Experimental Forest in South Carolina. It is a well stocked pure loblolly pine stand 50 years old on a 90-foot site, in which fire has been excluded for at least 15 years. A tally of the understory reveals over 5,000 stems per acre; about half are below breast height and the others mainly in the 0 to 1-inch class. There are also nearly 4,000 stems of woody shrubs per acre. Thus there are about 9,000 competitors in the understory."

The composition of the typical hardwood understory has been described by Chaiken as sweetgum, blackgum, southern red oak, water oak, willow oak, and such woody shrubs as southern waxmyrtle and gallberry. On the drier sites, many of the same species occur plus post oak, turkey oak, blackjack oak, and hickories.

Chaiken has also discussed the treatment and control of the understory hardwoods by chemicals and by fire.[2] A suggested treatment of hardwood understories in immature even-aged pine stands is periodic applications of winter prescribed fires. Such fires will usually kill aerial parts of hardwoods up to 1 to 2 inches in diameter. The hardwoods sprout, but the sprouts can again be killed by winter fires just before they reach the 1- to 2-inch d. b. h. class. This practice had been adopted as part of the management of the Francis Marion National Forest, which surrounds the Santee Experimental Forest.

It was soon observed, however, that there were many areas on which understory hardwoods could not be controlled by winter fires. Too many of the hardwood stems were too large. On these areas, which had been protected from wildfire for 15 years, the use of winter fires for hardwood control had been delayed too long. The purpose of the prescribed summer fires described in this article was to render such areas suitable for hardwood control through winter fires.

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[1] Chaiken, L. E. the behavior and control of understory hardwoods in loblolly pine stands. U. S. Forest Serv. Southeast. Forest Expt. Sta. Tech. Note 72, 27 pp., illus. 1949.

[2] Chaiken, L. E. the use of chemicals to control inferior trees in the management of loblolly pine. U. S. Forest Serv. Southeast. Forest Expt. Sta., Sta. Paper 10, 34 pp., illus. 1951.

The effects to be expected from summer fires were known in general from the writings of Chaiken and from observations of the effects of wildfires. It was to be expected that summer burns would kill hardwoods 3 to 4 inches in diameter, thus reducing a large part of the hardwood stands to sprouts which could be treated by winter fires. The techniques of summer prescribed burning were not so well known. Accordingly, a few trial areas were set up upon which to gain experience in handling summer prescribed burns.

One block was burned in 1949, two in 1950, and two in 1951. The conditions on these blocks were similar. In each case, the even-aged loblolly pine overstory was 30 to 40 years old or older and had been thinned for pulpwood to a basal area of about 80 square feet. Measurements were not taken but site indexes are about 70 to 80 feet.

According to the management plan, the rotation age is 80 years. None of these stands was to be reproduced in the near future and no reproduction was desired at this time. The hardwood understory was heavy and many of the stems were more than 2 inches in diameter. Each area had received a winter fuel reduction burn 1 or 2 years previously. It was, of course, necessary to reduce the 15-year accumulation of fuel by a winter fire before attempting a summer burn. The conditions under which each of the areas were burned is shown in table 1.

TABLE 1.—*Date of prescribed burn and burning conditions on 5 selected blocks, Francis Marion National Forest*

Block	Area	Date of burn	Burning conditions				
			Days since ½ inch rain	Fuel moisture	Wind velocity	Burning index[1]	Air tempt.[2]
	Acres		*Number*	*Percent*	*M. p. h.*		*F°.*
Von Holland	130	8/12/49	5	6	1-2	4	93
Rice Field	300	6/27-29/50	9	5	4	10	99
Clayfield	500	6/28/50	19	5	3-4	15	94
Honey Hill	650	6/25-27/51	13	3	3-4	20	95
Echaw	300	8/29/51	7	3-4	2-3	10	95

[1] Type 5 C W Meter.
[2] Maximum at Santee Experimental Forest.

These areas were burned by strip fires. The term "strip fire" is used locally to describe one in which narrow strips, 25 to 100 feet wide, are set afire in succession, each burning with the wind into the previously burned area. The use of strip fires is necessary in order to take advantage of the wind to carry the fire and yet not have an uncontrolled head fire going.

The results on each of the areas were similar. Except in damp, low places or areas of thin hardwood fuel, practically all 4-inch hardwoods were killed. Many 6-inch hardwood trees were killed.

Some survived but with basal scars almost encircling the stems. The pine crowns were not scorched. After a year or two the dead hardwood stems are down and there are only low sprouts on the areas. The woods have an open and parklike appearance which is in marked contrast to the almost junglelike understory on adjacent unburned areas. The hardwoods on the areas are obviously now easily controlled by periodic winter fires as needed. The few hardwoods which escaped the summer fire may safely be ignored for the time and treated as individuals at the time of regeneration of the pine stand. Since the areas were relatively small for prescribed burning and the work was experimental, the costs per acre were about one-third more than the usual cost of winter prescribed burning. Including planning, plowing, and burning they ranged from 20 to 30 cents per acre.

All areas except Von Holland are on the Wambaw Ranger District and were supervised by District Ranger William E. Howell. All of these burns were carried out by Fire Control Aid John T. Hills, Jr., who has had more experience with prescribed burning on the Francis Marion than any other member of the organization. The success of these experimental summer prescribed burns is due largely to his knowledge of fire behavior and his skill in controlling it. He furnished the data on burning conditions reported in this article. As a result of these tests of summer burning, Hills has the following comments to offer:

"1. A number of sample checks should be made over the area to be burned in order to determine moisture content of the lower layer of fuel. If the partially decomposed litter is not damp severe damage to the pine may result. This is believed to be a better index than number of days since rain.

"2. Wind velocity should be from 1 to 3 m. p. h. If less than this the fire cannot be controlled. If higher, the heat does not rise and damage hardwood crowns. Heat at base or stem level is also dissipated too quickly. The light wind will remove hot air between hardwood crown and pine crown preventing scorch in the pine.

"3. The distance of stripping should not be more than 25 to 100 feet varying with the amount of fuel, also size of hardwood. If lines of fire are farther apart there is the tendency to create a chimney effect and in each instance severe scorch will result.

"4. In older stands of loblolly, particularly in bottoms, there is usually a buildup of fuel at the base of the trees. Sometimes the winter fire does not remove this rough because of damp conditions. Care should be taken not to burn such areas with summer fire because of the concentrated fuel."

This condition was observed on the Clayfield block where partial basal girdling of overstory pines occurred.

It is evident from these tests that summer fires can be used to reduce hardwood understories containing stems with diameters too large to be killed back by winter fires in middle-aged loblolly pine stands. The work is difficult, however, and requires exceptional care and skill in prescribed burning. Even under such treatment, some risk of damage to the pine overstory is present.

PRIVATE-COUNTY-STATE-FEDERAL COOPERATION GETS RESULTS IN UTAH

R. CLARK ANDERSON

District Ranger, Cache National Forest

The main line of the Union Pacific Railroad is a double track road through Weber Canyon in North Central Utah. Six miles east of Ogden, Utah, this line passes through a rugged, narrow canyon about 4 miles in length, a portion of which is appropriately named Devil's Gate. It then passes east through the gently sloping valley of the Weber River where it winds along among cultivated fields and farm houses. It leaves the Weber at Echo Junction passing through a broad 30-mile canyon known as Echo Canyon and out onto the flat plains of Wyoming.

Since the driving of the Golden Spike at Promontory Point in 1856 completed the rail span of the continent, range and forest fires have been started by sparks coming from the stacks of the iron horses that rode these rails. And along these lines—as all over the nation in those early days—these fires were looked upon as insignificant. They were just a thing that had to be lived with. Anyway, what damage did they do? That grass and brush on the sidehills and plains was not worth much. It would come in again.

Soon after the turn of the century the concept of protection and conservation of *all* of the nation's natural resources began to change. By the early thirties there developed a national appreciation of the value of all plants and animal life. Especially was it found that plants are essential in keeping the soil in place to prevent erosion and consequent siltation and damage to downstream improvements.

In 1935, the boundaries of the Cache National Forest were extended so that the Federal agency could assist in fire control work. The steep portion of Weber Canyon near Ogden was included in this addition. There followed an act in the 1937 Utah Legislature which made it unlawful for any private landowner to allow a fire to go uncontrolled on his own land, either to endanger his land and improvements or those of his neighbors. This act also set up a fire control agency to cooperate with private owners, and other governmental agencies in the State, including towns, cities, and counties. This agency was called the Utah Board of Forestry and Fire Control. This board was set up in 1941 as an amendment to the 1937 law.

It was an obvious fact, in sizing up the fire job in the Northern Utah area, that the Union Pacific Railroad right-of-way through Weber Canyon was a problem area. The east bound track was located above the west bound and was consequently closer to the

unprotected grass and brush, which becomes tinder dry on this hot south exposure in late summer. Coal-burning engines doubled up on this stretch and, laboring mightily to haul loaded trains up the rather steep incline, naturally threw large sparks far up the slope. Most of the Weber and Echo Canyon rim is through a canyon that is narrow and winding, thus obscuring the baby fires from the section crews working elsewhere in the canyon. The resulting large fires on steep rocky terrain were exceptionally difficult and costly to control. In the 13-year period, 1939-51, there occurred in the lower Weber Canyon portion more than 25 fires, 3 of which grew to over 300 acres in size. The others were over 10 acres with the exception of one Class A (under 1/4 acre) and two Class B (1/4 to 10 acres). During this period other disastrous fires occurred in the upper or Echo Canyon area.

By tackling the problem on a cooperative basis, the railroad, the Utah State Forester, and the U. S. Forest Service have accomplished much.

1. The railroad has reduced the number of coal-burning engines. During the fire season they agreed to send as few as possible of the coal-burning variety on the Ogden-Green River run in the interest of holding down the fire hazard. Where use of coal burners is necessary, the railroad tries to schedule them between 6:00 p.m. and 10:00 a.m. during period of lowest hazard.

2. The railroad constructed a 10- to 15-foot fireline above the tracks, in all portions of the lower canyon where a bulldozer could work. This line is worked each spring upon advice from the Forest Service as to the proper time to do the work before the fire season. In portions of the canyon where a fireline is not possible the section crew burns a protective strip each year at the same time.

3. In the upper canyon the Summit County Commission and the State Forester jointly finance a patrol and prevention guard for the county. Much of his time in early season is spent in advising and assisting the railroad in fireline construction and burning out above the right-of-way. He also checks on any engines which are "spark throwers" and the railroad immediately removes these machines from service until arrestors are repaired.

4. The cooperative program has been worked out by means of a meeting each spring in which Federal, State, county, and railroad officers are represented. A plan for the season is agreed upon at this meeting.

5. Each spring the counties, State, and the Forest Service jointly conduct fire training schools in the three counties (Weber, Morgan, and Summit) crossed by the railroad. The company sends each of their section crews and even extra gangs, who will be in the area for the summer, to these schools. Each of the foremen of these crews is deputized as a Deputy State Fire Warden.

6. The Forest Service, the State, and the railroad exchange current lists of men who are available for fire fighting in case help is needed.

7. An attack plan is worked out whereby the railroad takes initial action on any fires that occur when and where they have men available. Usually the Forest Service or the county receives

first call. They check the railroad to see if men are available or already on the railroad fires. The Forest Service fire guards, who are stationed in the lower area, and the State-county guard in the upper canyon take first action on all fires that come to their attention, the railroad, the county, or the U. S. Government reimbursing them, depending on the land ownership involved. A written cooperative agreement on the various responsibility and action phases of this job are at present being worked out.

8. The Forest Service supervises action on all fires within the forest boundary that threaten Government land and in the absence of qualified overhead from the railroad on railroad fires. The State Fire Wardens in each county (usually the sheriff) supervise work on fires which are not caused by the railroad and which are on private land within the forest boundary or are outside the boundary.

A combination of these activities has borne fruit. (1) There were no fires caused by the railroad in the lower canyon in 1953 despite a long and critical fire season. (2) In 1952, several railroad fires were set early in the season. All were attacked and suppressed at less than ¼ acre except one, which reached two acres in size. (3) First attack by railroad crews on other fires has been extremely helpful. These crews have also provided extra trained fire fighters for use of other agencies. All of these men have undoubtedly become more fire conscious and have spread fire prevention to others.

As a result of the combined efforts of all interested groups, the railroad fire problem in Weber Canyon has been minimized. Especially is the railroad, and the transcontinental highway it parallels, much safer from flood damage which usually follows removal of the protective vegetative cover from the steep slopes above.

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Reinforcing Rear Bumpers of Pickups

Rear bumpers of pickup trucks often become bent from backing into something in the woods, especially when on night fires. The bumper also serves as a step in loading men into back of truck. The edge of the bumper is narrow and when wet is slippery and unsafe to use as a step. These disadvantages have been remedied by installing a piece of 2- by 10-inch pine or oak plank inside the bumper, the plank being cut to fit the curve of the bumper. It is fastened in place with two ⅜-inch carriage bolts through the plank and the flat iron supports on the bumper. Since bumpers are designed to absorb some shock, a space of 1½ to 2 inches can be left between the curved edge of the board and the inner edge of the bumper. This plank provides a safe step for getting in and out of the truck, prevents the bumper from bending easily, and cuts down noise considerably. It can be painted to harmonize with the truck and to prolong its life.—H. W. JANNELLE, *District Ranger, Alabama National Forests.*

CALIBRATION OF FUEL MOISTURE STICKS USED IN THE EAST AND SOUTH

Ralph M. Nelson

Southeastern Forest Experiment Station

The moisture content of forest fuels, however estimated, is a major variable in any system of fire-danger measurement. It is doubly a controlling factor in the system developed by the Southeastern Station because it enters into both the buildup index and the daily burning index as measured by the type 8 danger meter used throughout the Northeast.

A simple method of estimating moisture of lightweight materials, such as hardwood leaves, dead weeds and grass, and pine needles, was developed some years ago by the Southeastern Station. In field practice, three basswood slats, which constitute a set, are exposed 8 inches above the forest litter on wire supports. To obtain a close approximation of the moisture content of lightweight fuels, a set is suspended at one end of a pivoted beam-type scale designed by G. M. Byram of the Station. The balance is so constructed that the sliding counterweight can be moved to correspond to the oven-dry weight marked on the slats. The other end of the beam then points directly to the moisture percent on a vertical arc graduated from 0 to 50 percent. Thus, no converting of stick weights to moisture percent is necessary.

In addition to indicating the moisture content of surface fuels, the sticks are used to determine the buildup in fire danger. This is done by summing buildup factors derived from daily fuel moistures. For example, percents of 3.9 or less have a factor of 10 and those over 20 have a value of 0. Intermediate percents have values ranging between these extremes. The buildup index reflects the progressive drying of lower fuel and upper soil layers. When fires occur during periods when the buildup index is on the increase, they burn more deeply and become progressively more difficult to control and mop up.

Each year the Southeastern Station processes and distributes about 1,300 sets of fuel-moisture indicator sticks to about 650 fire-danger stations scattered from Maine to Texas. These stations are operated mainly by State and Federal agencies but also by industry and a few schools and military installations. Because of the widespread use of these fuel moisture sticks, it was thought that a brief description of the several steps involved in processing would be of interest.

Basswood slats 18 inches long, 2-3/8 inches wide, and 1/8 inch thick are procured from manufacturers of venetian blind stock. The material comes fairly free of defects but is sorted to remove all cracked, knotty, or discolored slats. A small hole is bored at one end of each slat through which a small metal grommet is riveted. The purpose of the grommet is to permit easy suspension from the hook on the scale when moisture determinations are made.

Basswood slats when exposed under field conditions lose a certain amount of weight through weathering. To minimize this loss, they are pre-weathered on racks (fig. 1) for several months until they have lost approximately 5 percent of their weight. Length of exposure depends upon season of the year. We find that slats weather faster in summer than in winter and faster during hot, rainy weather than at other periods. The point at which slats have lost sufficient weight is determined by the periodic weighing of test sets—the original oven-dry weight of which is known—placed at intervals among the sets being weathered. After proper weathering, slats are inserted in a rack and oven-dried according to the following schedule: 2 hours at 68° C., 1½ hours at 80°, 1½ hours at 92°, 16 hours at 105°. Forced air circulation is used in the oven at 92° and 105° temperatures. With our equipment, 56 sets constitute a charge.

Slats are next taken from the oven in groups of three and quickly weighed as a set to the nearest 0.1 gram on a beam-type balance to determine the oven-dry weight. Weight and serial number are penciled lightly on each slat. The oven-dry weight of a set, to meet standards, must be between 90 and 105 grams. If an occasional set falls outside of this range, a lighter or a heavier slat, as may be required, is substituted until weight requirements are met.

After oven-drying, the charge (56 sets) is placed overnight in a forced circulation humidity chamber. The purpose is to identify those sets which absorb moisture either too quickly or too slowly. Approximately 300 grams of water placed in a pan inside the chamber is sufficient to raise the average slat moisture to the desired amount of 4 percent. Following humidification, the sets are again weighed and the median moisture content of the 56 sets calculated. Those deviating from the median value by more than 0.4 percent are put to one side and later redried and rehumidified. If they fail a second time to meet the allowable deviation they are discarded. Another point of value resulting from this humidifying

FIGURE 1.—Approximately 2,700 basswood slats are being pre-weathered on these racks.

step is that any sizable errors in determining oven-dry weights are immediately detected.

Finally, sets that meet above specifications are permanently marked on the less weathered side of each slat in indelible pencil with the year, serial number, oven-dry weight of the set, and stamped, "Expose Other Side." Because sets lose approximately 0.5 gram during each of two 6-week periods of field exposure, a weathering correction card is prepared for each set. Following this, sets (fig. 2) are individually packaged in envelopes and are then ready for mailing. Distribution is made twice a year to all danger station observers except those in northern New England and the Adirondacks, where a single set is sufficient.

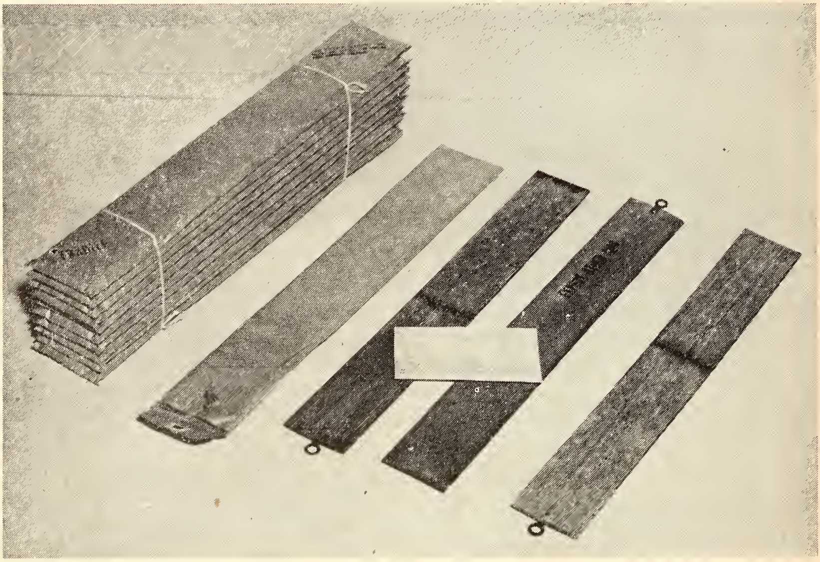

FIGURE 2.—Sets of calibrated fuel moisture sticks ready for distribution.

Readers who desire additional information regarding our fuel moisture sticks and their use are referred to the following publications:

Byram, George H.
The Appalachian fuel moisture scale. Jour. Forestry 38: 493-495. 1940.

Lindenmuth, A. W., Jr., and Keetch, J. J.
Fuel moisture sticks are accurate. U. S. Forest Serv. Fire Control Notes 9 (4) : 18-21. 1948.

Jemison, George M., Lindenmuth, A. W., and Keetch, J. J.
Forest fire-danger measurement in the eastern United States. U. S. Dept. Agr. Handb. 1, 68 pp., illus. 1949.

Keetch, John J.
Instructions for using forest fire danger meter type 8. Southeast. Forest Expt. Sta. Sta. Paper 33. 1954. (*Also in* Fire Control Notes 15 (3) : 40-46, illus. 1954.)

PRESCRIBED BURNING IN THE NORTHERN ROCKY MOUNTAINS

CHARLES T. COSTON

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Prescribed burning got its start in the longleaf pine region of the South, where silviculturists discovered that controlled burning of the forest floor litter not only increased timber productivity, but improved grazing and wildlife habitat, served as a fungus control measure, and reduced dangerous fuels.

Such fuel reduction is of major importance here in the northern Rocky Mountains, where the dense stands of reproduction and fire-killed trees, steep slopes, and extremely dry fire seasons create optimum burning conditions. Fuel reduction is designed to rid the forest of areas containing dense, highly flammable fuels, and to increase the economic value of the land. Both suppression and presuppression costs are reduced by the resulting lower fire hazard.

Areas of dense fire-killed timber can produce only a scattering of green timber for the many years that nature is disposing of the dead trees, at most no more than 10,000 ft. b. m. per 100 years. The same type of area, however, when prescribe-burned, can produce at least 20,000 ft. b. m., and the best sites can increase volume production to as much as 40,000 or 50,000 ft. b. m. per 100 years.[1]

Since the outbreak of the spruce bark beetle epidemic in Idaho and Montana in 1951, prescribed burning has been used very successfully as a means of destroying these insects (fig. 1). Areas of infested Englemann spruce are usually clear-cut, because the perecentage of infestation runs very high, often to as much as 100 percent. The logging leaves a great deal of slash and tops as well as unmerchantable trees, all of which contain a large number of beetles. These areas are then broadcast burned, the result being the death of the beetles.

Generally speaking, the best time of year to prescribe-burn is in the fall. In the northern Rockies a moderate rain usually comes during early September, followed by a period of warm, dry weather. This is the time when most burning is done. No attempt to burn should be made when conditions are not good enough to assure a clean burn. A general guide for weather and fuel conditions needed to accomplish the desired type of burn is as follows: (1) Relative humidity 25 to 50 percent; (2) wind 8 m. p. h. or less; (3) fuel moisture 8 to 12 percent; (4) burning index 30 to 40.

[1] LYMAN, C. K. PRINCIPLES OF FUEL REDUCTION FOR THE NORTHERN ROCKY MOUNTAIN REGION. U. S. Forest Serv. North. Rocky Mountain Forest and Range Expt. Sta. Progress Rpt. 1, 98 pp., illus. 1945.

FIGURE 1.—Broadcast burning of slash on a logged-over area in the Lolo National Forest infested by spruce bark beetles. Standing trees are western larch, a fire-resistant species, which will serve as a seed source to regenerate the area.

Proper planning of a prescribed burning project is of vital importance. The area to be burned should be prepared well in advance of the planned date of burning. Then there should be a certain amount of leeway to allow the project manager to take advantage of weather conditions.

The preparation of an area usually consists of constructing firelines around the proposed burn, felling dangerous snags, and in some cases felling standing timber to assure fuel continuity. Arrangements for an adequate control force should be made. This will depend upon the characteristics of the area to be burned.

On moderate slopes, lines may be built most economically by bulldozer. On slopes up to 60 percent and in light fuels the hand trencher may be used, but on steep slopes, lines must be built by hand.

All snags that are likely to throw spots should be felled within 200 to 300 feet inside the line. All rotten and shaggy barked snags near the outside of the line should also be felled. All dangerous snags should be felled on small areas and on long narrow areas.

Dozer piling along critical sectors and the burning of these piled areas well in advance of broadcast burning reduces risks.

Mr. Lyman states that, "Experienced judgment is necessary to size up fuel conditions and to determine the most desirable flammability conditions to wait for. The most desirable condition

for heavy fuel types is a calm, quiet afternoon with overcast skies and relative humidity between 20 and 34 percent. Fuel moistures of 6 to 9 percent are best, depending upon fuel type."

The Weather Bureau can predict suitable weather for burning. Ideal conditions would be a period of calm weather followed by rain a day or two later. This would lessen the mopup job which is necessary on most burns.

Since wind is the most variable adverse condition that threatens the success of a prescribed burning project, it is the condition that should be watched most closely. In the northern Rockies, morning winds are generally from the east, since the sun warms the east slopes first. Then the winds shift to the south and increase in velocity. During midmorning, upslope winds start with the rising of heated air from lower elevations. The upslope winds continue until late afternoon when downslope winds start as a result of cold, heavy air draining back into the lower elevations. Highest wind velocities usually occur in midafternoon.[2]

A knowledge of fire behavior is necessary in prescribed burning. The project chief must know the air currents created by fires, how to draw fires together, how to lead fires into different areas of the burn. He must know when to set fires in certain areas of the burn so that all of the fires will draw together and assure a good burn.

The element of timing cannot be overstressed. Proper timing of sets prevents spot fires, and it determines the effectiveness of the burn. This is the main reason that propane torches are preferred in firing. They are fast and dependable.

While the afternoon is generally the best time to burn, under certain conditions night burning is more advisable, especially when daytime burning hazards are very high and there is considerable danger of spotting. Night burning also enables one to take advantage of the downslope winds. The fire can be set along the upper edge of the burn, and the wind moves it downhill until the fire builds up its own updraft and reverses. Then another row of sets is made below the line of fire and the lower fire draws the upper fire down to it. Under certain conditions fires may thus be led down a slope. This method is not considered to be the best because there is considerable danger of losing on the uphill side as a result of lack of heat inside. Fires have a natural tendency to spread uphill.

A better method of firing on the slopes is to set a triangle of fire well inside the proposed burn, and to allow heat to develop well downhill and inside. Then the fire can be worked in a point uphill to the line and led out to the line on all sides by progressive firing. Buffer strips can be used to ease fire up to the line. Care should be taken to fire right up alongside the line in progressive firing, and to set hot fires well inside to draw the fire away from the line.

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[2] Barrows, J. S. FIRE BEHAVIOR IN NORTHERN ROCKY MOUNTAIN FORESTS. U. S. Forest Serv. North. Rocky Mountain Forest and Range Expt. Sta., Sta. Paper 29, [122] pp., illus. 1951.

On level ground the circular method of burning can be used with a high degree of success. Hot fires are started in the center of the area to be burned, and they pull air in from all sides. Then fires are set around the outside of the circle and are drawn in to the center.

The key to success in controlled burning lies in a competent control force. This enables the use of hot fires without the constant danger of their getting out of control. All the equipment deemed necessary should be on hand: Tankers (fig. 2), dozers, trenchers, anything that makes the burn safer. Of course there is a financial limit. Therefore, it becomes necessary to use fires in such a manner as to never get more fire than the control force can handle.

FIGURE 2.—A jeep tanker being tested prior to the broadcast burning of an area of lodgepole pine slash, Deerlodge National Forest, Mont.

In prescribed burning there can be no set guides to be used on any particular area during any season. Each region has its own topography, fuels, and weather, and each area within a region has fire-affecting peculiarities all its own. Before burning, therefore, each area must be studied carefully. Slope, wind, fuels, any factor that might possibly affect fire behavior must be carefully noted, and a detailed plan of action must be made to suit each specific proposed burn.

Fire has taken its place along with the other tools of the silviculturist, and it promises more uses and benefits as we become more familiar with its effects.

INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed in the manuscript immediately following the paragraph in which the illustration is first mentioned, the legend being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

When Forest Service photographs are submitted, the negative number should be indicated with the legend to aid in later identification of the illustrations. When pictures do not carry Forest Service numbers, the source of the picture should be given, so that the negative may be located if it is desired.

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FIRE CONTROL NOTES

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A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

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FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 16 Number 2

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the

TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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CONTENTS

OPERATION FIRESTOP

R. KEITH ARNOLD

Professor, University of California School of Forestry

The effectiveness of mass-fire as a weapon was proved in World War II. Because of this, mass-fire is a civil defense problem that faces all agencies concerned with fire. Such questions as how and where will enemy-induced fires start, how can they be suppressed, and what organization and techniques are required to hold property damage and loss of life to acceptable limits for national survival are only a few of the many to be answered. In addition to this, we have our day-to-day peacetime fire problem. Why do fires burn as they do? What are the combinations of weather, fuel, topography, and fire pattern that can be used to predict spread and behavior? Which patterns set the stage for blowups? What combinations preclude any possibility of dangerous fire conditions? Are there chemicals now available that will effectively retard or stop wild-land fires? How can fires be attacked quickly in inaccessible places?

Because of these perplexing questions, Operation Firestop was established in January 1954 as a cooperative project to make exploratory studies in two research areas: civil defense against fire and the reduction of loss from large wild-land fires through the development of new or unconventional fire control measures. It is designed as, and limited to a one-year operational study, with a three-months field test program, ending July 1, 1955. Without exception, key personnel in the organization are men with other regular jobs and responsibilities. For the most part, the project relies heavily on earlier basic research studies and recent technological developments.

Manpower, equipment, and facilities for Operation Firestop are from many sources, principally the fire services themselves. These include the California Division of Forestry, the U. S. Forest Service, the Los Angeles County Fire Department, the Los Angeles City Fire Department, and the Pacific Intermountain Association of Fire Chiefs. Support is also provided by the Federal Civil Defense Administration and the California Office of Civil Defense. Certain activities of the U. S. Department of Defense make it possible for it to furnish facilities and the assistance of the following branches: Marine Corps, Camp Pendleton; Air Fleet Marine Force Pacific; Sixth Army Headquarters; Eleventh Naval District; Air Force and its Air Weather Service.

Research and equipment-development groups produced the strongest research program for Operation Firestop that could be established in the time available. These groups are the U. S. For-

est Service California Forest and Range Experiment Station and the Service's Equipment Development Center, the University of California School of Forestry and the University's Los Angeles Engineering Research group, and the U. S. Weather Bureau. Many industries, principally chemical, aircraft, oil, and communications, felt the significance of the project and searched through their products for those adaptable to fire control problems. In all cases industry contributed men and materials generously.

Operation Firestop developed in a mushroomlike fashion. In the spring of 1954, plans were prepared, cooperators contacted, and equipment obtained. Site preparation began in May, but the 3-month field program did not start until July 1. All field work except wind survey and fuel measurements was stopped October 1. The working group averaged about 40 men. Two hundred test fires required the construction of 25 miles of firebreaks, 10 miles of roads and jeep trails, 3 heliports, and installation of 22 weather stations, 18 wind towers, and 14 continuous recording stations. (Fig. 1.)

The research program is divided into five studies. Prior to analyses of data, only preliminary results can be summarized in the following paragraphs.

Fire retardant studies show that readily available chemicals can be sprayed in water solution on forest fuels to make limited quantities of water go farther and to extend the time that prewetting of those fuels is effective. The flanks and rear of a fire, and sometimes even the head, can be stopped by chemical firelines. A hot crown fire in heavy brush will often drop out of the crowns when it hits chemically treated fuels, and its rate of spread may

FIGURE 1.—One of the Firestop test areas from the air, showing plots, firebreaks, and roads and trails constructed for the project.

thus be reduced by as much as 50 percent. Backfires can be started from chemical lines that are established faster than adequate firelines can be cleared (fig. 2). Smoldering spot fires can be held down by chemicals until conventional ground forces attack them. It also appears that chemical firelines can be put in by aerial application. The disadvantages: chemicals are expensive; they have to be applied at rates varying from 4 to 10 pounds per 100 square feet of treated fuel, and they still require conventional mopup and patrol work.

FIGURE 2.—Backfiring from a brush strip (left) sprayed with fire retardant.

Firing technique studies show that backfires can be made to burn when weather and fuel conditions are such that backfiring will normally not work. These tests included one method of drying out green vegetation in 6 to 8 hours by spraying with various weed killers, adding diesel fuel, smashing brush, dropping incendiaries from the air, and fanning by helicopter.

Fire behavior studies attempted to develop more accurate dimensions and specifications for fires. Fuel and microclimate measurements were made on all test fires. In addition 11 fires were set specifically to develop means of measuring heat transfer characteristics of the fires themselves. This information may in the long run be the most valuable to come out of Firestop.

The *wind survey* was designed to develop methods for conducting large-scale wind surveys to aid in predicting wind behavior in mountainous areas. Surface weather data were recorded at 22 weather stations, 18 wind towers, and anemometers hanging from cables across canyons in one of the principal drainages of the test area. Air soundings of temperature, humidity, and wind were made from ground level to 20,000 feet twice a day and oftener during critical burning conditions. In addition to their primary

objective, these data also serve to record the actual conditions under which other Firestop tests were conducted.

Application technique studies were largely concerned with aerial delivery of water and other retardants. A torpedo bomber was rigged to drop 600 gallons of water or chemicals from its bomb bay. This craft puts a heavy drench over an area 50 feet wide and 270 feet long. The Sikorsky S-55, the Hiller 12-B, and the Bell 47 helicopters were used for water bombing and to lay hose; 1,000 to

FIGURE 3.—*Top*, Small helicopter pulls hose from tanker live reel to inaccessible part of fire in a few seconds. *Bottom*, Helitanker unit picked up by large helicopter can be placed nearly anywhere on fireline.

2,000 feet of hose can be laid over rough terrain in less time than it takes to charge the line. In addition, the larger Sikorsky was used to drop 100 gallons of water by free fall on spot fires and along firelines, and for delivery of a small hook-on "helitanker" unit made up of a 100-gallon tank, small pump, and 300 feet of hose. This unit can be picked up from a truck or a tool cache and delivered to nearly any place on a fire with men to operate it. (Fig. 3.)

This sketch of Firestop tells in brief what was done but at the same time raises two important questions: How can these developments be applied in fire control? What is the part further research can play in fire control?

First, reports on each phase of the study which will be coming out this winter will present more detailed descriptions, results, and limitations demonstrated by the actual tests. Most of these new things, though, still require additional testing and equipment development since Firestop will only carry each successful idea to the point where its feasibility is demonstrated. Since most Firestop developments are for special or critical situations, men must then be trained to recognize these situations and apply the control measure to match.

In answer to the second question, even with the fine work of the U. S. Forest Service fire research units, the Fire Underwriters' Laboratory, the National Fire Protection Association, and others, Operation Firestop has demonstrated that the present total fire research effort falls far short of being able to keep us abreast of modern technology and scientific development. In contrast Canada and Great Britain both have National Fire Research Laboratories with appropriate staff and facilities.

Firestop has not provided answers to the many fire problems before the fire services and civil defense agencies. It has shown us, however, that concentrated research effort can bring results; and it has pointed the way to some important improvements. Firestop agencies are enthusiastic about the potential for improved fire control which lies in a permanent large-scale fire research program and are now concentrating on making this potential a reality.

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Blotters for Flannel-board Placards

The general issue, white 9- by 4-inch blotters make satisfactory placards for presenting flannel-board subjects during training sessions. Paper cards must be backed with sandpaper or otherwise treated so that they will cling to the flannel, but the blotters need no treatment. A felt-tip marker is an ideal freehand scriber for preparing the blotters.—KEITH MACDONALD, *Fire Control Officer, Tahoe National Forest.*

FOREST FIRE RESEARCH AS IT LOOKS IN 1955

A. A. Brown

Chief, Division of Forest Fire Research, U. S. Forest Service

During World War II my first work for the Chief's Office took me on a tour of every region. There were a lot of interesting things happening everywhere. One small incident that was amusing at the time may have a point today. On one district the ranger had lost a lookout to the military services, so he picked a young fellow from his trail crew to fill the position. He was a bright chap with a lot of initiative and ingenuity but without much accurate knowledge of the woods. A few days later the ranger was in the vicinity of the tower so he hiked up the trail to see how the lookout was getting along and to give him some training in his new duties.

When the ranger was about 50 yards from the tower there was suddenly a zing of wire, something grabbed his right foot, and before he knew what was happening one leg was hoisted up in the air, his pack sack was over his face, and he banged his head on a rock. When he had recovered a bit from his bewilderment he found he was hung up by a loop of No. 9 wire. It took some scrambling around to get untangled and back on his feet looking like a self-respecting forest officer, and there was probably some fire in his eyes. It developed that the lookout had been told a lot of bear stories before he went up; he was worried about defending himself properly. He knew from Boy Scout days how to build a noose rabbit trap, so building on that knowledge he had fashioned a whole series of bear-sized rabbit traps out of wire he found at the tower. I don't recall what became of that lookout, but he was a bright chap—he had plenty of initiative and ingenuity, and he made use of the best he knew. We'll come back to him later.

We are now in the first 10 years of the atomic age. Science and technology are moving at a faster rate than ever before in history. This is particularly true of military research and development but is by no means confined to the military. Pick out the growing industries—every human activity that is pushing ahead now has the flow of new knowledge from research and development to support it. I have been fortunate enough to see this demonstrated firsthand. It is a stimulating thing, and it is also a challenge to us concerned with fire. If we can do a good job of bringing modern techniques to bear, I think we can eliminate heartbreak and coronary ailments as occupational hazards to fire control officers. It can't be done overnight, but we have the advantage of strong allies.

War clouds still hang over us. Any war now is going to be a fire war. The last war was only a start in incendiarism. Millions of dollars are now going into research on how to use fire more effectively as a weapon of war. Civilian officials of city, town, and country are beginning to demand research in *defense* against fire. Because of this, we find that our small group of researchers are

very much in demand. They are in demand by all fire agencies because they know most about the behavior of big fires that respond to the free play of weather factors and atmospheric conditions. The group we have organized at Berkeley is part of our response to that demand and the cooperative project "Operation Firestop" is another. There is no one in forest fire research who wouldn't prefer to tackle the forest fire problem directly. But we are getting much needed basic research through going cooperative projects and they are helping us to build a stronger technical base for all future work.

What are some of the possibilities that are developing through forest fire research? First of all, research is evolving what might be termed a better concept of the third dimension in fire behavior. This third dimension is the amount of heat energy produced. We used to think of a going fire as a two dimensional control problem, like a problem in plane geometry. The fire was increasing its perimeter at a given rate, if fireline could be built at a faster rate, the problem was easily solved. This approach is valid only if the heat energy is below certain levels. A better measure of the controllability of a fire is the amount of heat energy it is developing per minute, just as you might rate the horsepower of a motor. Where heavy fuels prevail, an area of 100 acres or less may release energy equivalent to the 20 kiloton A-bomb, such as described in the Civilians Atomic Handbook. On some of our big fires the release of heat energy goes up to the equivalent of exploding one of these bombs every 5 to 10 minutes.

The effect of this energy release is the reason our blow-up fires have so many mysteries. It gives new meaning to atmospheric conditions at the time, and to vertical as well as the commonly measured horizontal air movements. It helps to explain the "fire storm," a phenomena already known to most experienced forest fire fighters in the West. It gives new meaning to fuels and to the significance of measures to reduce their volume. When we speak of how fast they burn, we are really saying how fast they release their energy. We find that there is a whole story in the thermal qualities of fuel, what the scientist terms "reflectance, absorption, transmission, etc." These ideas show us a new approach to our problems but they will have to be translated for operational use.

Close aerial support of ground fire fighting, the skilled use of chemicals and even water, still await development, though each has promise of great contributions to our problems.

A whole new methodology, called Operation Research, has grown up. It consists of a task-force attack in solving the repetitive type of problem: aerial support, lightning prevention, long-term forecasting, better extinguishers, more flexibility. Just as nationally we are preparing to defend ourselves without mass manpower, I think we can look toward methods in fire control where technics and skill can replace futile mass attack by manpower. If we don't muff our chance to keep up with progress, in 10 years we can look back to some of the things we are doing now and laugh at the ingenious bear traps we once used.

DETACHABLE HOSE ROLLER FOR TANKERS

JOHN V. DAVIS

Fire Control Assistant, Mendocino National Forest

Re-rolling cotton-jacket fire hose by hand is a slow, awkward job. Sometimes it is done in the woods, before leaving the fire. The result is a loose, unworkmanlike roll, bristling with pine needles, foxtails, and similar "whiskers." Sometimes the hose is thrown into the truck in a heap and carried to the station for rolling. In this case, the truck and crew are not really prepared to make another efficient water attack until the hose has been rerolled.

Forest Warehouseman Alvin M. Edwards and I designed, perfected, and built a detachable hose roller for use on tankers. It has solved the problems listed above. With it, one man rolls a length of hose in less than a minute and does better than a factory job. All Mendocino tankers now carry the device as standard equipment.

The hose roller is made to roll hose with both couplings on the outside (and with male joint protected), in the standard fashion prescribed in R-5 handbooks. This permits fast coupling and fast unrolling without "barber poles."

The hose roller consists of an axle, a split hose reel, a handcrank to turn the reel, and a guide to line up the hose with the reel (fig. 1). All parts are constructed of lightweight material. The device is collapsible and is easy to assemble and operate. A pair of 3/4-inch pipe flanges spaced 17 1/2 inches apart are mounted permanently on both the back and the right side of the truck to allow attachment of the roller in either of two positions. The location of the unrolled hose in relation to the truck determines the best position of the roller to minimize dragging hose and maneuvering the truck.

The four parts of the roller are easily stored away in the truck when the roller is detached. The parts in order of assembly are: (1) The axle the reel turns on. This is a piece of 3/4-inch pipe 7 inches long. Threaded on one end, it screws into one of the pipe flanges on the truck. (2) The reel slips over this axle. The reel is in halves, each half made up of four 1/2-inch steel-tubing spokes. The spokes, each 13 inches long, are welded to a hub. They are crimped at the outer ends and bent slightly outward to prevent catching on the hose. The back half of the reel has a 1/4-inch pin welded to the hub 1 inch from center to hold the hose while rolling. This pin fits into a hole in the front half of the reel to lock the reel halves together. The reel is adjustable for 1-inch or 1 1/2-inch hose. (3) The handcrank fits over the squared hub of the front half of the reel. (4) The guide which lines the hose up with the reel screws into the other 3/4-inch pipe flange on the truck. This guide is a 6-inch length of 3/4-inch pipe with a 3-inch washer welded at the midpoint. Another 3-inch washer is welded to a

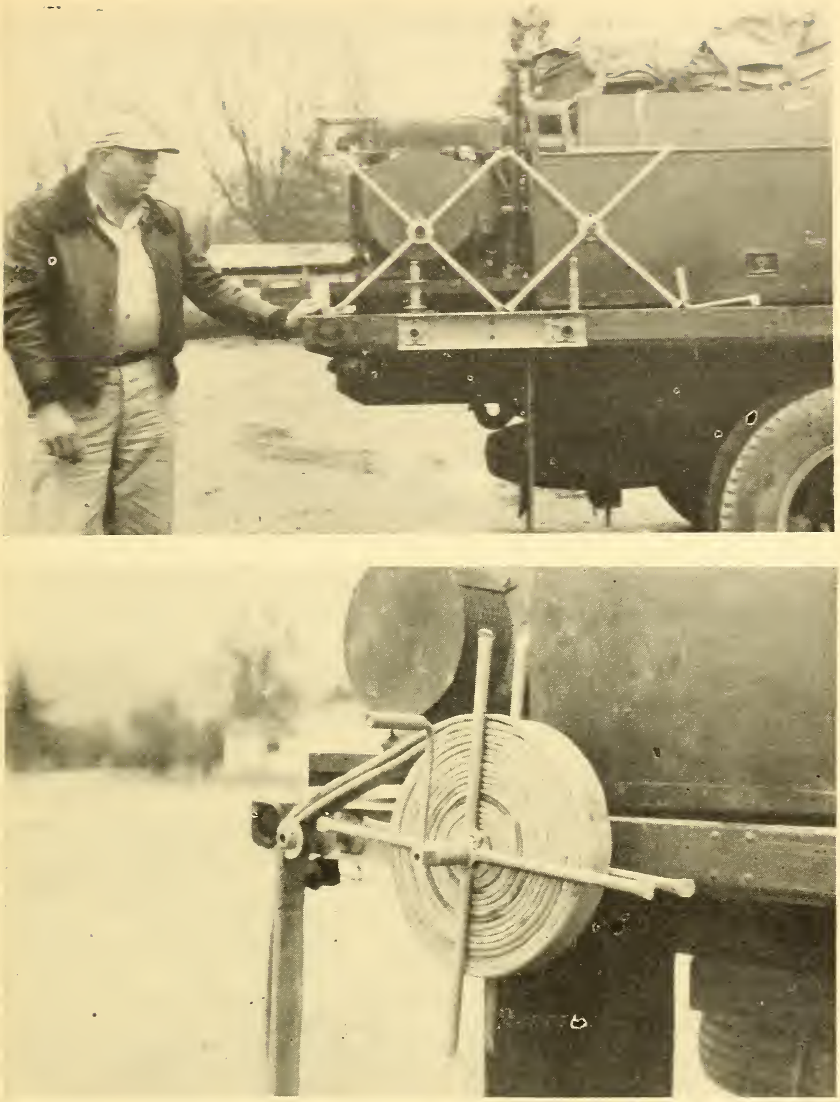

FIGURE 1.—*Top,* Mounting flanges and unassembled hose roller; *bottom,* assembled hose roller.

sleeve that slips over the pipe and allows adjustment of the guide for different size hose.

A rubber band about an inch wide cut from any used inner tube can be used to hold a rolled length of hose while it is being removed from the roller. To remove a roll of hose and to insert another length for rolling, only the outer half of the reel need be removed from the axle.

MICHIGAN'S IMPROVED FIRE FINDERS

GILBERT STEWART and MAX BRADLEY

Forest Fire Experiment Station, Michigan Conservation Department

In 1951 the Michigan Forest Fire Experiment Station started investigations dealing with improved types of fire finders. Analyses of field requirements emphasized the need for accuracy in directional readings; hence, use of larger azimuth circles became imperative. A review of existing types of fire finders was made, and importance was placed upon accuracy and simplification in operating the instrument itself.

As a result of these investigations, several models of fire finders were designed and pilot models were made at the experiment station. Two final types were produced, both using the same basic azimuth plate. Each has a "parallel offset" mechanism that permits the upper limb of the instrument to be moved 5 inches, to either the right or left of the center position. A total motion of 10 inches enables a towerman to position the instrument so that it will miss obstacles that normally obstruct a line of sight, such as corner posts and window framing. This design eliminates need for shifting the cabinet top.

The azimuth plate consists of a high-grade aluminum casting 17 inches in diameter, graduated in numbered intervals of 10 degrees; 5-degree and single-degree markings are shorter; single degrees are the smallest subdivision on the circle. It is possible to estimate 10-minute readings by controlling the width of marking line on the plexiglass indicator attached to the alidade. The casting includes a base ring on the under surface as well as a center hub, and reinforcing ribs of ample size. Final weight of the finished azimuth plate is 8-3/4 pounds.

Castings are produced commercially over patterns supplied by the experiment station. The technique of casting figures into the plate against a stippled background guarantees numbers of bold, clear outline, and fine appearance. Casting figures into the parent metal has a number of advantages. It eliminates the need for stamping, engraving, or otherwise numbering each individual plate. Figures of decorative appearance result, and these require machine surfacing only to assure sharp definition. However, pattern work must be of high quality, and special types of figures must be chosen for the basic pattern. Castings of this kind and quality can only be obtained from manufacturers of memorial plaques. Most commercial foundries are unwilling to guarantee production of castings that have a sharp definition of figures and that are uniformly free from defects.

Machining operations for finishing castings are standard in machine shops. Surfaces of plates are turned and polished on large swing lathes. Figures are faced on a vertical milling machine, using a rotary table for accurate positioning under the spindle; the graduations are cut on a shaper, using a rotary table with indexing plate. To assure quality control and uniformity in manu-

facture, the usual compliment of patterns, fixtures, gages, and jigs has been produced. These items are manufacturing conveniences that facilitate quantity production.

A studbolt, especially designed for the purpose, is used to mount the plate on top of the tower cabinet; a large wingnut clamps against the underside of the cabinet top, after the azimuth plate is oriented. The top of this same bolt provides the pivot for the alidade. Since direct readings are taken at the rear end of the alidade, the azimuth plate must be oriented with the 180-degree division pointing true North.

The offset alidade consists of two basic parts. The lower limb rotates on a pivot on top of the studbolt and is locked in any desired position with the jamnut. Attached to the lower limb is a plexiglass indicator with a zero line on the underside that permits the azimuth reading to be taken and estimated within 10 minutes of angle.

The upper limb of the alidade is attached to the lower half by two arms that are held in a parallel position at all times. The principle involved is identical with that used in the mariners' parallel rule. Because of the three-tier design of the instrument, the top limb passes completely over the lower one to either side of center; a total movement of 270 degrees is possible.

A choice of two sighting devices has been provided for. One instrument uses the conventional vane type of sight (fig. 1, *top*). The second instrument is equipped with an erecting telescopic sight of approximately 3-power (fig. 1, *bottom*) ; all controls for the telescope provide micrometer adjustment and correspond in principle to those employed on surveying transits. It is equipped with a military type of reticle marked by a circle and dot. Because of the design of assembly and mounting, it is essential that the telescopic unit be kept light and compact.

In selecting a telescope of approximately 3-power, a preliminary study was made of more powerful instruments up to 20-power. Proper magnification may prove to be a matter of personal preference and individual eyesight. However, it is noticeable that smoke columns have blurred outlines, and when viewed through optical instruments of high power, border contrast is less well defined than through glasses of lower power. The instrument that may prove most useful from a magnification standpoint is not yet determined; field checks are being made by towermen. In addition to increased magnification, optical instruments offer possibilities of employing haze filters to extend range of visibility. Filters could be supplied as attachments and used as required.

During the fire season of 1954, 76 fire finders of the parallel-offset type were used in the Upper Peninsula of Michigan, Region I. At that time the aluminum azimuth plate was not fully developed, and a plastic disk was used. At the present time a manufacturing program is underway at the experiment station under which 70 units, like those shown in the photographs, will be built and issued to Regions II and III for use during the fire season of 1955.

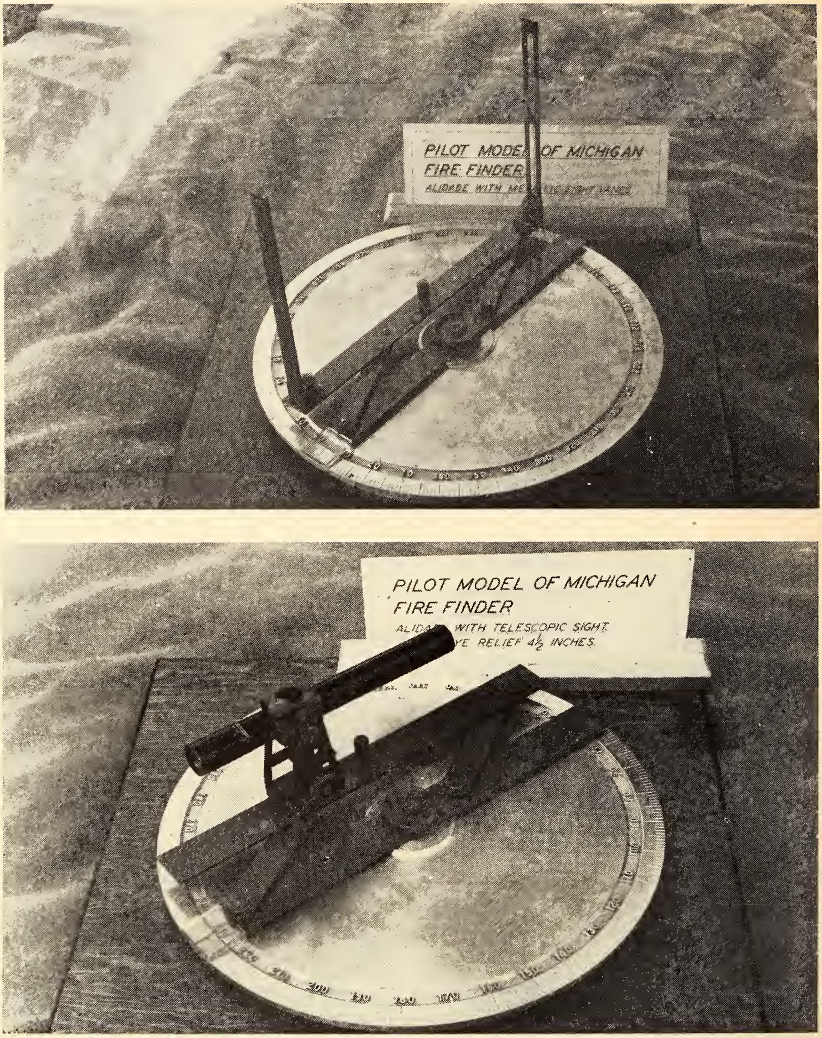

FIGURE 1.—Offset alidade: *Top*, with vane-type sight; *bottom*, with telescopic sight.

Full blueprint details have been completed on the entire assemblies; and patterns and tooling have been developed for manufacture. Material cost for the assembly using the metallic sight vanes approximates $28 based on 70 units; the type using the telescope has a material cost of $55 based on 50 units. Total costs include metal finishing, and the finishes have been kept as simple as possible. All steel parts are colored deep black as in gun finishing. The natural color of the metal in the aluminum plates will be retained unless it proves to reflect excessive light.

FIRE TOOLBOX FOR STAKESIDE TRUCKS

RICHARD F. JOHNSON

Fire Prevention Officer, Angeles National Forest

The problem of how to transport a crew of men and their tools safely on the same stakeside truck has plagued all of us for a long time. The usual method of carrying tools in boxes on the bed of the truck reduces the seating capacity and makes the tools inaccessible for immediate use. Because stakeside trucks with portable seats leave no safe place for carrying tools, the tools must be transported separately in a pickup. This means that frequently men and tools do not arrive at the same time or at the same location.

We recently designed and built an all-metal fire toolbox that has eliminated these problems. The new box, which takes advantage of the space under the bed of the truck between the cab and the rear wheels (fig. 1), is made of 16-gage metal and is 61 inches long, 16 inches high, and 20 inches deep. The door is 14-gage metal, 61 inches long, and 11 inches high, and is mounted with a piano hinge and equipped with slam locks. Welded to the back of the box are 2 brackets made of 2-inch by 1/2-inch flat iron, which fit over the frame of the truck and are held in place by set-bolts. Below each bracket is a 1-1/4-inch pipe spacer, 5 inches long, which rests against the frame of the truck and holds the box rigid. Tool racks were purposely left out of the interior of this box to insure maximum flexibility in type and number of tools that can be carried.

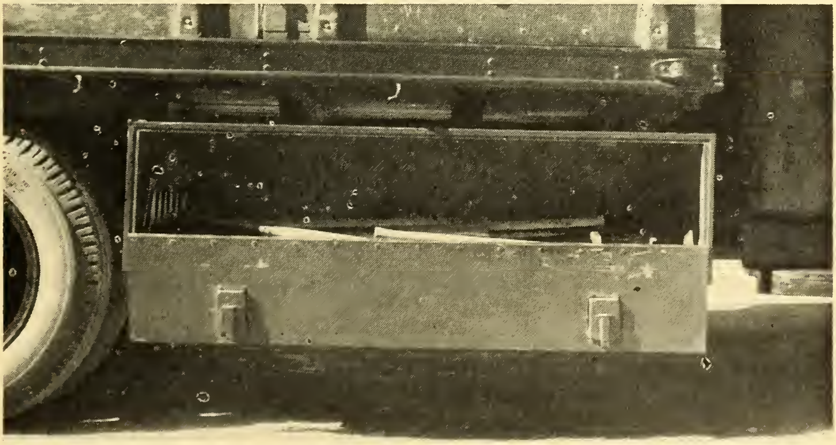

FIGURE 1.

The box is designed to fit any standard stakeside truck without adjustment, and it can be installed or removed in a matter of minutes without special tools.

SWIVEL HITCH FOR FIRE SUPPRESSION PLOW

ARTHUR E. GREEN, *District Forester,* and CHESTER O'DONNELL, *Specialist in Visual Aids, Texas Forest Service*

When and where the first swivel hitch for pulling fire-suppression plows was developed is not known. More than 2 years ago, in an effort to overcome the disadvantages resulting from a rigid coupling between the plow and the mobile unit pulling it, the Texas Forest Service began experimenting with a swivel hitch of its own.

In the past, most suppression plows have had a small degree of traverse or none at all. This lack of traverse or lateral movement hindered the maneuverability both of the plow and mobile unit. Because the plow came out of the ground on short turns, it did not plow a smooth, even fire lane, and it had to be raised to allow the mobile unit to back up. Installation of the swivel hitch has corrected these deficiencies (fig. 1).

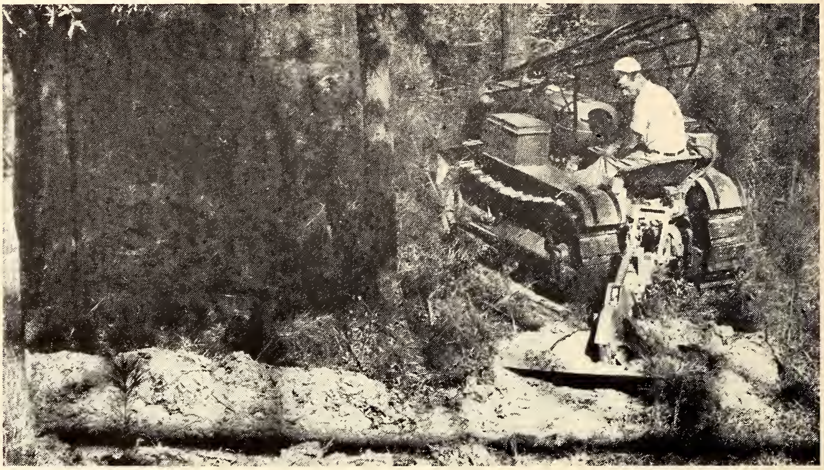

FIGURE 1.—Turns of very short radius are permitted when the plow is attached to tractor by means of a swivel hitch. Plow is shown at extreme left end of lateral arc.

The swivel hitch is rather simply constructed, but it is made very strong in order to withstand the abuse and strain to which it is subjected (fig. 2). The hitch attaches to the end of the drawbar of the mobile unit and is mounted on a heavy steel pin on which the entire hitch depends. This pin, or hub, is braced to the rear of the mobile unit to give it extra strength for handling large plows, and as an additional protection against strain. The vehicle's hydraulic lifting unit is attached to the hitch, and a seat and lock for the plow to fit into is provided so that the plow can be locked

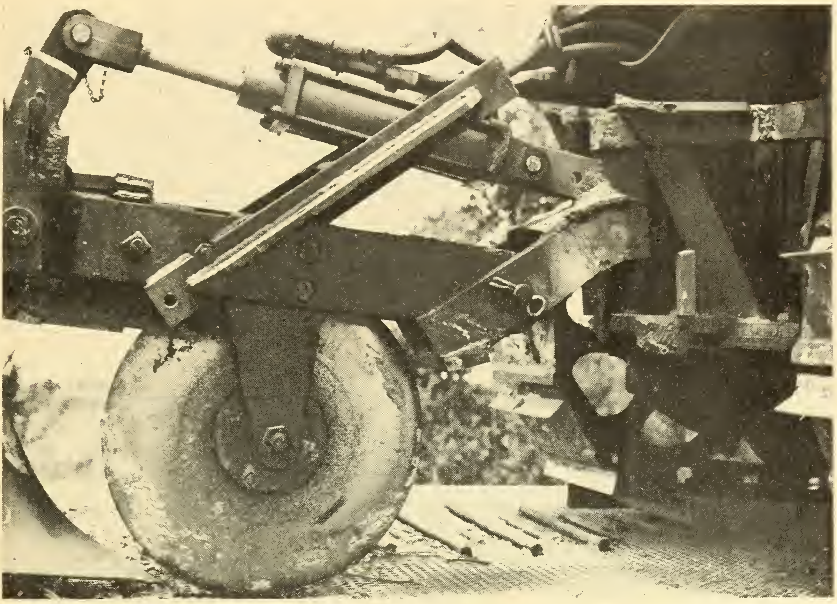

FIGURE 2.—Method of attaching plow to tractor by means of swivel hitch.

in place for cross-country movement. This locking seat prevents the plow from swinging from side to side on the rear of the mobile unit, thus saving wear and tear on all of the equipment involved and preventing possible property damage and injury.

Very little additional rigging is needed on a mobile unit to handle the plow, and the swivel hitch can be fitted on either a jeep or tractor. Several adjustments make it possible to set the plow for different types of soil.

One of the commercial disk-type plows now in use by the Texas Forest Service was modified to fit the swivel hitch. This modification consisted of eliminating the three-point suspension arrangement on the plow, and lengthening the beam for attaching the hitch. This also resulted in making the plow lighter. Attaching the plow to the swivel hitch was a comparatively easy matter, but considerable difficulty was experienced in designing a lock to hold the plow in a raised position while traveling. Many different locking designs were tried, but none proved satisfactory until one was designed by M. S. Lawrence of the Texas Forest Service. Although this locking device has had no field trial and will undoubtedly have to be modified through trial and error, it appears to be very satisfactory.

The new swivel hitch, as developed by the Texas Forest Service, seems to have justified all of the work and planning that went into its design and construction. Both it and the modified plow are to be produced commercially.

DROOP TAIL ATTACHMENT FOR STAKEBODY TRUCKS

Frank D. Mayfield, *Ranger*, and Joseph J. B. Kennedy, *Assistant Ranger, Alabama National Forests*

In October 1944, the Alabama National Forests received two 25-horsepower crawler tractor-plow units which were put into service as their first mechanized units of fire control equipment. These units were to be transported on two stakebody trucks, a 1-1/2-ton and a 2-ton. It was at once apparent that a safe and efficient means of loading and unloading the tractor-plow units was needed as well as a means for lowering the center of gravity and stabilizing the position of the plow unit while the tractor-plow unit was being driven to and from the fire.

In the early part of 1945, Forest Engineer Noland, with the assistance of Automotive Mechanic Saxon, designed and constructed two droop tail attachments for the two stakebody trucks. These droop tails were designed for rigid type installation, i.e., welding all connections, including the welding of the assembled droop tails to the truck chassis, and were therefore fixed units.

As fire suppression activities became better mechanized, there necessarily resulted an increasing investment in costly and specialized fire control equipment which in most instances was restricted to use for a single purpose. The disadvantages of single-purpose use were particularly evident in the stakebody trucks which had been equipped with "fixed" droop tail attachments and could be used advantageously only during the fire season. It also became apparent, through observation of the loading and unloading of the tractor-plow units, that a safer and more efficient means of handling, fastening, and transporting the run planks was needed.

In an effort to eliminate the disadvantages noted in existing equipment, Noland, with the assistance of the district ranger and Mechanic Stewart, modified the original design of the droop tail to make it detachable, and constructed two units. Figure 1 gives a general idea of the way the droop tail is constructed and fastened to the standard stakebody bed. The plow is in its normal riding position with the stiff leg folded up over the run plank opening. In figure 2, the plow has been lifted to show the stiff leg in position and the run plank opening. One plank is hooked in place ready for unloading while the other rests on its rollers ready to be pulled out.

The stiff leg is fastened by strap iron hinges to a 3/4-inch rod running through pipe welded to the frame. It is made of angle iron and swings down in position under the frame of the droop tail unit to keep the truck from tilting when the tractor is being loaded and unloaded. In this position, the stiff leg must be in contact with the ground so that it will brace the droop tail. When not in use, the stiff leg folds up flush against the floor of the droop tail and over the opening for run planks, thus keeping them from slipping out. The flanges of a Morgan Hitch-type plow fit over the corners of the stiff leg when it is turned up. With other plows it is necessary to secure the stiff leg with a chain attached to a bolt in the platform decking.

FIGURE 1.—Droop tail and its bracing; plow in traveling position.

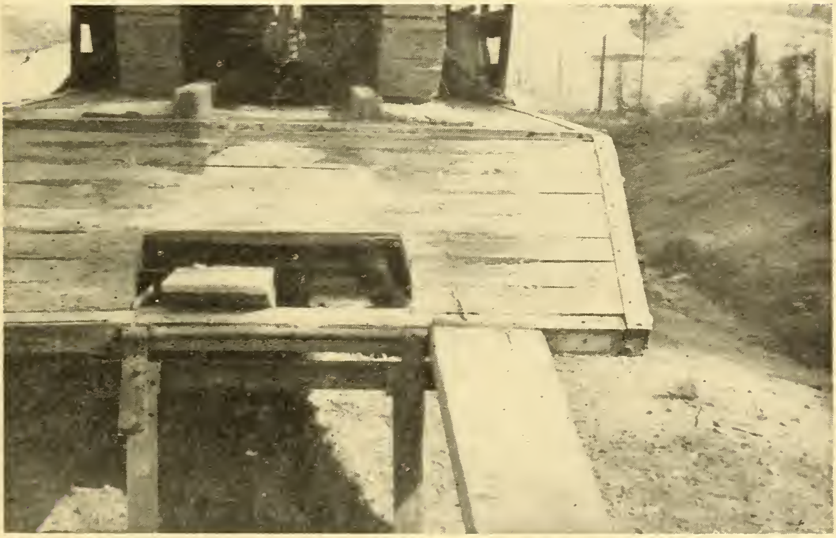

FIGURE 2.—Stiff leg in position. Rollers make it easy to pull out run planks.

This detachable droop tail and roller carrier arrangement for run planks has given superior service in the field. It is economical to construct and, in addition, can be taken off a truck in a matter of a few minutes, releasing the vehicle for other work. Detailed specifications can be obtained from the Regional Forester, U. S. Forest Service, 50 Seventh St., N. E., Atlanta 5, Ga.

FIRE CONTROL COOPERATION AT TALLADEGA, ALABAMA

H. W. JANELLE

District Ranger, Alabama National Forests

One night recently my telephone rang, and when I answered it: "Is this Ranger Janelle?" "Yes." "This is Burt Carlson, of the Coosa River Newsprint Co., you've got a fire down on the Wiregrass Road, near the Trammel Motorway, about 5 or 6 acres." "Okay Burt, thanks a lot, we'll be right down there and take care of it."

Another night near Sycamore, the Coosa River Newsprint Co. arrived with a plow and tractor unit and helped us control a fire before it reached national-forest land. The forester for the Kaul Lumber Co. often arrives with men and equipment at fires on or threatening national-forest land near Hollins, Ala., and stays until they are out, or until we tell him we can handle them alone. The State units usually have their hands full, but quite a few times we have worked together along the boundary of the Talladega National Forest to put out fires that could spread to national-forest lands. I mention the above occurrences because they are examples of the excellent spirit of cooperation between fire fighting outfits which has developed in this area over the years.

The Talladega Purchase Unit was established in 1935 and a program of land acquisition initiated. The area was given national-forest status by Presidential Proclamation on July 11, 1936. That year there were 511 forest fires on the Talladega Ranger District which burned an estimated 8,500 acres of Government land. A correspondingly large amount of private land was burned within the Talladega Forest boundaries. Organized fire protection was placed in effect in 1937, the first such attempt in this part of Alabama.

In the beginning the odds seemed insurmountable, and there was every indication that we were going to have to fight a lone battle. When crews went out to fight a fire, they were alone, no help was offered, and the attitude of the people was often hostile. Local residents wanted the woods to burn, and they felt that we were foolish to try to stop the spread of fire when they thought it was inevitable that the countryside would burn no matter what we did.

A change came in 1942 when the Kaul Lumber Co. hired a forester, Lewis Weaver, to manage its large holdings around Hollins. These lands were intermingled with ours through the whole southeastern part of the Ranger District. Weaver was an implacable foe of uncontrolled fire, and from the very beginning, the Forest Service and the company worked hand in hand. Our lookouts spotted fires on company land while in other cases the company found fires on our lands, often taking initial action. The

records show the results of such close cooperation in the present low number of fires and small acreage burned.

In 1945 the State appointed a ranger for Talladega and Clay Counties, another vital step in the development of strong forest fire protection. An outgrowth of cooperation between the State, the Kaul Lumber Co., and the Forest Service was a decision by the State and Federal agencies in 1949 that a lookout tower on Rocky Mountain would be advantageous to all parties. This point is the last high mountain of the Allegheny range, and overlooks the wide flat valleys of the Coosa and Tallapoosa Rivers, where they meet to make the Alabama River. The lookout would cover a large area of the national forest and command an excellent view of the lands protected by the Alabama Division of Forestry, including company lands.

Rocky Tower is an outstanding example of cooperation between organizations striving for the same objective. After agreement was reached, the lookout point was developed by 2 public and 3 private agencies, as follows:

1. The tower itself was furnished by the Forest Service, and was delivered to the foot of the mountain.
2. The Kaul Lumber Co. and Elmer Dunnam, a sawmiller and logger, furnished tractors and trucks and hauled the materials up the mountain over a temporary road.
3. A. O. Mitchell, the State ranger, with the help of other State men, erected the tower.
4. In 1950, the Coosa River Newsprint Co. furnished heavy equipment and built a good road up to the tower over a route laid out by the district ranger and John Raeburn of the Coosa Co.

About 1950 the Coosa River Newsprint Co. acquired large holdings of land within and adjacent to the national forest. By 1951, it had foresters managing and protecting its lands, and was equipping its crews with tractor-plow units and handtools. With intermingled ownerships and similar objectives, it was inevitable that we would work together. We furnished the company with information on our fire control organization and, in turn, the company gave us maps and information on its crews, equipment, etc. On many fires in the forest we have worked side by side regardless of ownerships.

The U. S. Pipe and Foundry Co. has for many years owned large areas in and near the forest. Until recently, no effort had been made to control wildfires, but last year the company hired a forester to manage and protect its lands. Although it has no plows, the company has started to suppress fires and has done much to discourage promiscuous burning.

Two years ago a special radio link was set up between the State radio network and the Forest Service system. The Kaul Lumber Co. and the Coosa River Newsprint Co. are on the State frequency so there is a ready means of handling fire control business.

One of the most important results of close liaison between Federal, State, and private organizations has been the impression

made on the public. It often seemed that people felt, in connection with fire fighting, "that's what the Government men get paid for." However, when private industries lined up with us against fires, the people realized that it was because the companies knew that fire protection was good business.

If we ever get a really big fire around here, it is more than probable that the U. S. Forest Service, the Alabama Division of Forestry, the Coosa River Newsprint Co., and the Kaul Lumber Co. will all be on it. We have learned to work together, and have found that it pays big returns in effectiveness and good will.

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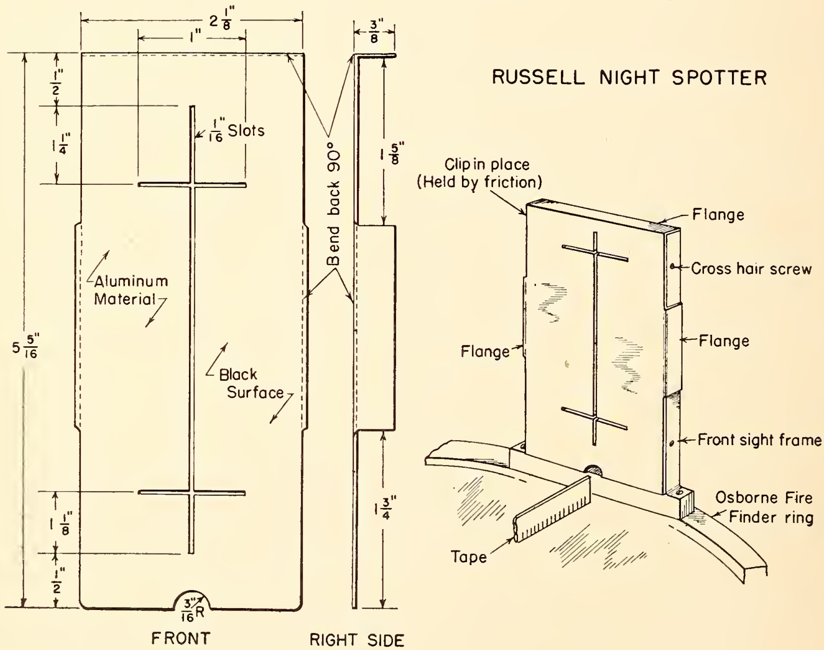
Russell Night Spotter

A simple but useful device for locating and obtaining azimuth readings on fires at night was developed last season and tested by Lookout George Russell, who has completed 40 years of service on South Fork Mountain of the Mad River District. The device is a detachable clip that fastens to the front sight of an Osborne Fire Finder. Slots, which can pick up minutely faint glows, superimpose the regular vertical and horizontal cross-hairs. Troublesome and inaccurate methods are eliminated with the spotter.



The clip is easily made with ordinary handtools, the best material being malleable aluminum sheet metal. Three flanges bent at right angles afford quick, sure, friction placement. The slots can be cut in with a hacksaw after drilling a start, and a black painted surface will intensify any glow appearing through the openings.—ROBERT C. JANES, *District Ranger, Six Rivers National Forest.*

ACCIDENTAL FIRES IN SLASH IN WESTERN OREGON AND WASHINGTON

William G. Morris

Forester, Pacific Northwest Forest and Range Experiment Station

Slash from clear cutting, the common practice in western Oregon and Washington, is an exceedingly dangerous forest fuel. During dry weather, fires in this fuel usually spread so rapidly and burn so hotly that they evade even strong and efficient control effort. Consequently records of fires that started in slash were studied to learn more about their cause, behavior, and control. The results showed logging and related activities caused 60 percent of the fires and these became much larger than fires from other causes. This emphasizes that the greatest losses from fire in slash are likely to occur during logging.

Detailed records of accidental fires which burned entirely in slash from the time of origin to the time of attack were analyzed in the study. All fires of this class occurring on clear cuttings within national-forest protection districts during the period 1950 through 1953 were included. Fires caused by the escape of intentional slash burning or debris burning were eliminated because the object was to learn the importance of slash in accidental fires. The number of fires available for study after these eliminations was 88.

The number and percent of fires by causes were:

Cause:	Fires	
	Number	*Percent*
Lightning	9	10
Logging equipment, logging operations, or smoking by loggers	53	60
Smoking by persons not associated with logging	12	14
Other causes	14	16
Total	88	100

Of the 53 fires caused by logging, only 7 were caused by smoking by loggers.

The fires were next put in three groups: Lightning, logging (including logger smoking), and other man-caused (including smoking by nonloggers and other man-caused fires not in the logging group). Then facts concerning the behavior, attack, and area of the fires were compiled from the standardized descriptive data on the individual fire reports.

Fire weather during the early stages of each fire was recorded as the burning index class (based on fuel moisture and wind) at the time the fire was discovered. These records showed no difference in fire weather among the lightning, logging, and other fires. For each cause, average burning index class was 3.5 on a scale that ranges from 0 to 10. Classes 9 and 10 rarely occur.

Character of each fire at the time when the first fire fighter arrives was recorded as either smoldering, creeping, running, spotting, or crowning. Of the three principal cause groups, logging

fires had the greatest proportion of fast-spreading fires; lightning fires had the smallest proportion.

Elapsed time from origin of the fire until it was first attacked averaged nearly the same for logging and other man-caused fires, but was ten times as great for lightning fires. In computing the average time for lightning and logging fires, one fire from each group was not counted because the discovery time of 5 days or more was excessive and would give an average obviously not representative. Excluding these fires, average elapsed time from origin to attack was: Lightning fires, 28 hours; logging fires, 2.9 hours; other man-caused fires, 2.7 hours. Comparisons of fires attacked within 1/2 hour, 1 hour, 2 hours, etc., showed that although the average attack time was about the same for logging and other man-caused fires, many more logging fires were attacked within 1/2 hour—43 percent of the logging fires and 15 percent of other man-caused fires.

Strength of attack was shown by the number of men used in the early attack stages and the proportion of fires on which bulldozers and machine-driven pumps were used. Logging fires were most strongly attacked. Number of men in the first attacking crew plus reinforcements arriving within 1/2 hour averaged 11.6 for logging fires, 5.9 for other man-caused fires, and 5.3 for lightning fires. The proportion of fires attacked with bulldozers within 1/2 hour after the first crew arrived was: Logging fires, 34 percent; other man-caused fires, 19 percent; lightning fires, 11 percent.

Area of logging fires when first attacked averaged several times as great as that for fires of other causes. Average size on attack for the 53 logging fires was 13.3 acres, but when three fires of more than 100 acres were eliminated, the average became 3.7 acres. Those from other causes averaged only 0.8 acre when first attacked.

Logging fires when finally controlled averaged much larger than the others. When one of 19,000 acres was eliminated, the remaining logging fires averaged 710 acres in size. Other man-caused fires averaged 23.0 acres, and lightning fires averaged 3.7 acres when controlled.

Possibly the reason for larger logging-caused fires in spite of quicker and stronger attack lies in a difference in condition of the slash. The logging fires usually start in more dangerous fuels than do other fires in slash because of the location of machines and men within slash of the current year. Other man-caused and lightning fires are as likely to start in older slash as in fresh slash. Slash becomes less flammable with age: the highly flammable needles drop from loosely piled branches to form a compact layer on the ground; vines, weeds, and brush moreover shield the fuel from the sun and wind. Furthermore, the older slash is more likely to be sparse and intrinsically a lower fire hazard because the highest hazard slash is usually intentionally burned soon after logging. In general, only the lower hazard slash is left unburned.

To see how fires in slash compared with those in other fuels, the average size of man-caused fires in all fuels was computed.

Logging fires in slash proved much the larger. For the period 1950-53 the average size of man-caused fires in all fuels was about 22 acres if one exceptionally large fire was excluded, about 39 acres if it was included. Either average is relatively close to the 23-acre average for other man-caused fires in slash, but only a small fraction of the average of 710 acres for logging fires in slash.

Rapid early spread and exceedingly large size of slash fires caused by logging emphasize the need for extreme care to prevent them. If a fire should start in current slash, every possible means must be used to attack with great force immediately after the fire starts.

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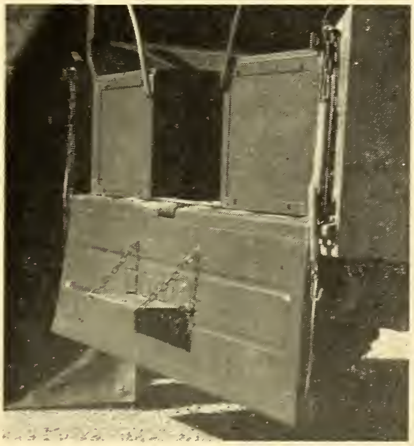
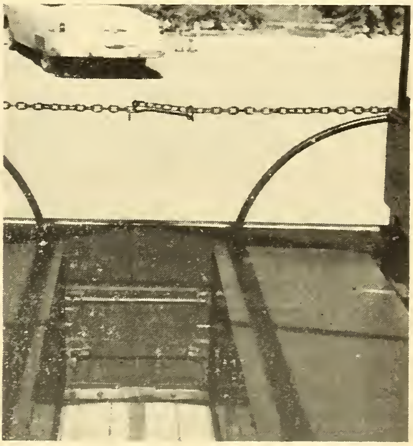
Tailgate Step for Power Wagons

Loading and unloading crews on power wagons has proved unsafe at times. With the tailgate closed the men must use the bumper as a step; with the gate open the step is too high. To reduce the hazards involved, a tailgate step was designed and proved practical in use.





The step is hinged to the tailgate in such a way as to automatically lay flat against the gate when the gate is closed and at right angles when the gate is open. The step is made of corrugated or rough boiler plate to provide a skidproof surface even when wet. Other types of skid-resistant tread could be used. The short step cannot be overloaded and need not be removed when the truck is being used for purposes other than transporting crews.—J. J. BALDWIN, *Forester, Gila National Forest.*

FIRE EXTINGUISHERS, THEIR TYPES AND USE. III. WATER-TYPE EXTINGUISHERS

A. B. Everts

Equipment Engineer, Division of Fire Control, Region 6, U. S. Forest Service

Everyone should have a basic knowledge of fire extinguishers and the type or class of fires on which these extinguishers are effective. No one type of fire extinguisher is effective on all classes of fires. These classes are as follows:

Class A fire.—A fire in paper, wood, cloth, excelsior, rubbish, etc.—or what we call forest fuels. For Class A fires the *quenching and cooling* effect of water is required.

Class B fire.—A fire in burning liquids (gasoline, oil, paint, cooking fats, etc.) in which a *smothering* action is required.

Class C fire.—A fire in *live* electrical equipment (motors, switches, fuse boxes, transformers, appliances, etc.). A *nonconducting* extinguishing agent is required.

To be sure, a fire may start as one class and then quickly develop into a second class—or even a third. In this case, it is necessary to use one or more types of extinguishers or methods to control the fire.

Let's remember, too, that fire extinguishers are first-aid treatment only. It's the old rule of "get 'em while they're small." There are three basic rules in extinguishing a fire with an extinguisher: (1) Locate the fire, (2) confine it so that it will not spread, and (3) extinguish it.

Now that we have the classes of fires in mind, let's go on to the basic types of fire extinguishers and the classes of fires for which they were designed. There are five basic types. Each major manufacturer has his own design. There are also variations within the type. The basic types are: (1) Carbon dioxide (CO_2); (2) dry chemical (dry powder); (3) water; (4) foam; (5) vaporizing liquid. Two of these types[1] were described in previous issues of this bulletin, and discussion of the others is planned for future issues.

The water-type extinguishers dealt with here are Class A extinguishers. The word "type" is employed because there are some interesting new extinguishing agents used in this extinguisher other than water.

There are three general types of extinguishers in this class: pump can; soda-acid; and loaded stream.

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[1]*Fire Extinguishers, Their Types and Use. I. Carbon Dioxide Extinguishers*, and *II. The Dry Chemical Extinguisher*, by A. B. Everts. Fire Control Notes 15 (4): 1-5, illus. 1954; 16 (1): 9-12, illus. 1955.

PUMP CANS: Pump cans, referred to as extinguishers, are usually the 2½-gallon size with a plunger type of hand pump and a short length of hose for directing the stream. They are so well understood that nothing further need be said about them.

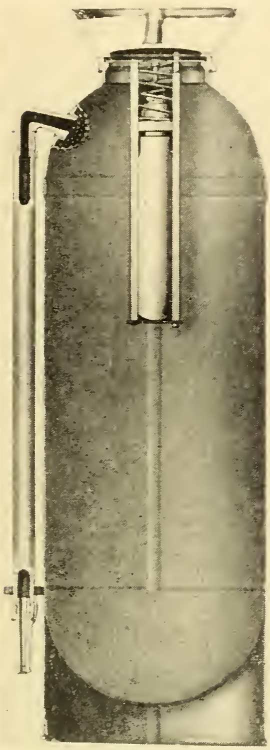

FIGURE 1.—Cut-away photograph of a CO_2 pressurized loaded-stream water extinguisher.

SODA-ACID: Soda-acid fire extinguishers have been in use for many years and are standard equipment with all manufacturers. Sizes vary, but generally the 2½-gallon size is one that is thought of when hand extinguishers are mentioned.

The extinguishing agent is water. A carbonate solution is premixed with the water, and a bottle of acid is suspended in a cage at the top of the extinguisher. To put the extinguisher into operation, the bottom is turned up. This action causes the acid to mix with the water solution. The resultant chemical action produces CO_2 gas, which expels the water directed at the fire through a short length of rubber hose. The range of the water stream is 40 to 45 feet. If it is possible to get close to the fire, a spray can be produced by placing a finger over the discharge tip.

In the past, most soda-acid extinguishers were made of copper. Newer models are made of stainless steel or silicon bronze and will withstand internal pressures up to 500 pounds per square inch. The list price of soda-acid extinguishers is approximately $30 and recharges cost $1.50 each.

Since the extinguishing agent is water, and water freezes at 32° F., the extinguisher is not a good one for use in cold climates, unless kept in heated rooms or other means of protection are provided.

WARNING: Nonfreeze compounds should not be added to the water in soda-acid extinguishers. To do so would cause a chemical reaction that would destroy the chemical charge and corrode the shell, and it might even result in an explosion.

LOADED STREAM: This term is applied to water-type extinguishers pressurized by a CO_2 cartridge (fig. 1).

In appearance and size, the extinguisher looks like the soda-acid foam extinguishers, size 2½ gallons. To operate, the extinguisher is inverted, grasped by the handle in the base (not shown in the cut-away photograph) and bumped down against the floor or ground. This action ruptures a disk in the CO_2 cartridge. The

released gas then expels the water. Stream range is 45 to 55 feet, somewhat farther than for the soda-acid extinguisher. Clear-water types are made of stainless steel and cost approximately $35 each. Drawn brass and silicon bronze, recommended when antifreeze salts are to be used, are about $5 higher. Used cartridges can be exchanged for charged ones for $1.00 to $1.25 each. Nonfreeze charges, which will permit use at minus 40° F. temperatures, cost from $1.75 to $2.75 each.

The loaded-stream extinguisher permits the use of extinguishing agents other than plain water, or the addition of a wetting agent to the water. There is indisputable proof that "wet water" increases the efficiency of water, especially in fuels such as excelsior, paper, and overstuffed furniture, where quick penetration is desired. Fire retardants can also be used. One of these, now available commercially, is of special interest. It was discovered by research chemists while attempting to develop a nonfreeze foam charge. This particular liquid remains effective down to minus 40° F. It is a fire retardant and prevents reignition. But its most surprising characteristic is that, unlike water, it is also effective on small Class B fires. This is an example of a Class A extinguishing agent that is also effective on small Class B fires. It should *not* be used on Class C fires.

The loaded-stream extinguisher, then, can be used to expel any liquid not corrosive to the container. Small-capacity fog or spray type could be used if there were any advantage in using them.

Maintenance.—Loaded-stream extinguishers require minor maintenance. Simply weigh the CO_2 cartridge to see that it is fully charged, and check the contents of the extinguisher. Soda-acid extinguishers require annual recharging, because the chemicals deteriorate with age. The extinguisher should be thoroughly cleaned and the hose checked to make sure that the nozzle is not clogged. Acid bottles and stopples, if replaced, should be exact duplicates of those originally provided. The powdered chemical should be thoroughly dissolved in water outside the extinguisher, in accordance with instructions on the container.

Summary.—(a) Use on Class A fires; (b) needs annual maintenance; (c) will freeze, *do not use antifreeze compounds*—except in the loaded-stream type; (d) range 40 to 45 feet.

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Red Hats For Fire Supervisors

An idea which we introduced on a fire in Gaspé last June and found to be a considerable benefit to the organization was the wearing of bright red hats by all rangers and auxiliary rangers. This enabled us to identify supervisory personnel at great distances and, also, served to advertise to the fire gang that the man giving them orders was a qualified ranger and not just some "joker" who happened to be passing by. We are now making up bright red arm bands to be worn by the crew foremen so that they too may be easily recognized in the excitement of battle.—D. M. JOHNSON, *Canadian International Paper Company.* (*From* Pulp and Paper Mag. Canada 55 (10): 191.)

TILT-BED TRUCK DEVELOPED BY TEXAS FOREST SERVICE

CHESTER O'DONNELL

Specialist in Visual Aids, Texas Forest Service

The tilt-bed truck, a new addition to mobile fire fighting equipment, appears to be one of the most important developments of recent years for the quick suppression and control of forest fires.

The tilt-bed truck, as developed by the Texas Forest Service, is a modification of a somewhat similar unit constructed by the United States Forest Service in Albuquerque, N. Mex. It provides for the rapid transportation of the heavy duty, tractor-type plow unit to the scene of action, and it is so constructed that one man can effortlessly load and unload the heavy unit that it carries. The tilt-bed truck has undergone extensive testing by the Texas Forest Service and, as a result of its highly satisfactory performance during these tests, the units are now being furnished to each of the six districts of the Texas Forest Service as standard equipment.

The very simplicity of design makes the bed easy and economical to construct. Essentially, the unit consists of a ruggedly built steel tilting bed mounted on a 1½-ton, or larger, truck chassis. The tilting movement of the bed is dampened and limited by shock absorbers. Two ramps that slide easily in and out of their grooves just below the level of the bed are provided at the rear of the body for use in loading and unloading. When extended, these ramps are held rigidly in the same plane as the tilt-bed body and become, in effect, an extension of the bed itself.

The tilt-bed received its name from the fact the body tilts downward for loading or unloading (fig. 1). This tilting motion is accomplished by mounting the flat steel bed onto the chassis of the

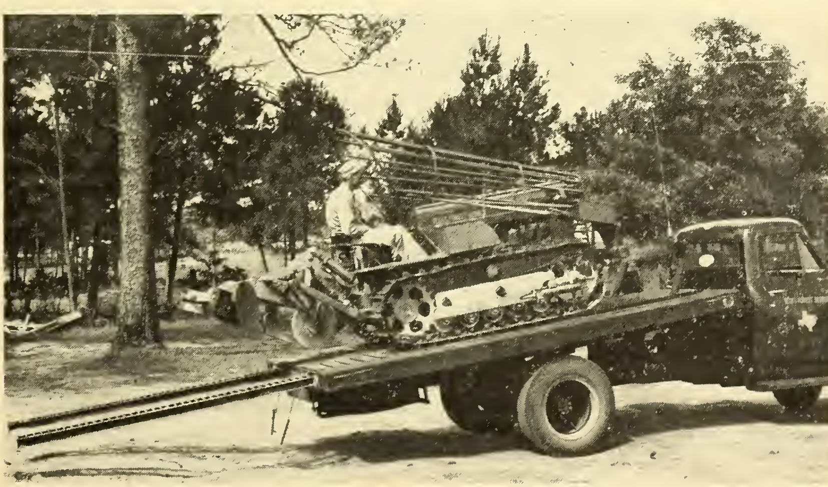

FIGURE 1.—Tilt-bed truck during one-man loading operation. Tractor unit has just passed center of balance and bed is returning to horizontal position. Pins attached to rear of truck are used to hold ramps in closed position.

truck in such a manner that it works on a pivot from a point at the exact center of balance. This action is similar to that of a balanced teeter-board.

In use, when it is desired to unload the tractor unit, the ramps are extended and the tractor is backed slowly off the truck. When the weight of the tractor passes the point of balance, the bed automatically tilts, the ramps rest on the ground, and the tractor is backed down the ramps to the ground. For loading, the process is reversed, and as the tractor nears the front of the tilted bed, it is gently lowered to the normal horizontal position. After sliding the ramps back into their grooves in the body, the unit is ready to roll.

To prevent the sudden drop that would occur when the weight of the tractor unit passes the balance point, an ingenious hydraulic shock absorber has been designed and installed between the frame and the front of the tilt-bed. A cushioning effect is achieved by means of a connecting, or bypass line from the top to the bottom of the hydraulic shock-absorber cylinder (fig. 2). By placing re-

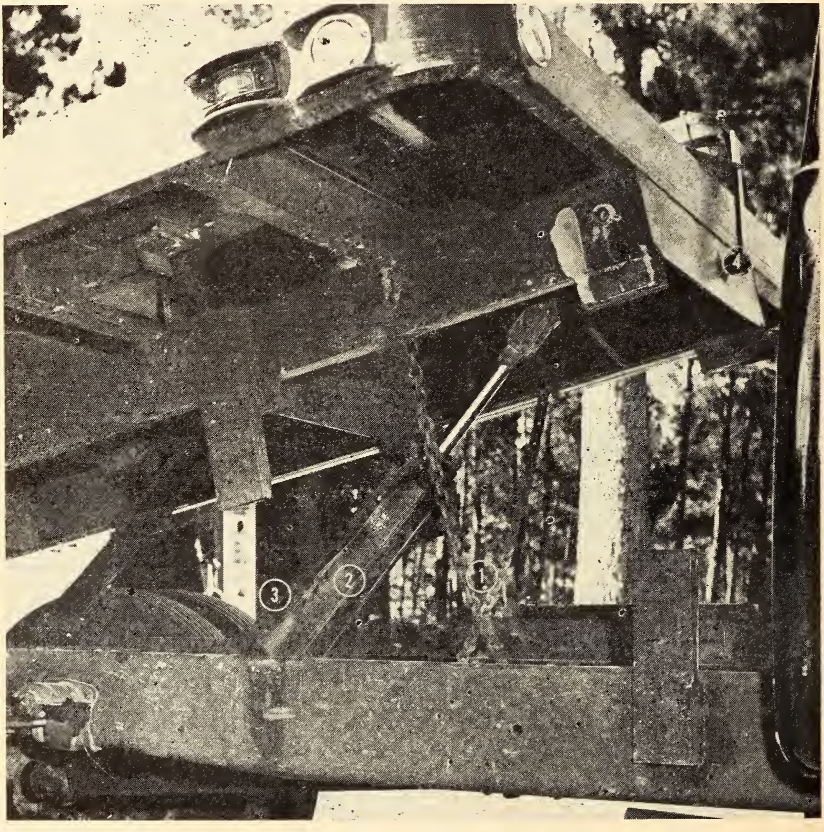

FIGURE 2.—View of bed tilted for loading or unloading purposes. Shown are (1) safety chains, (2) hydraulic shock absorber, (3) bypass line, and (4) locking device.

stricting apertures in this line, the speed of movement of the tilt-bed is controlled and the bed is allowed to move slowly and smoothly even under the heavy weight of the tractor.

Heavy duty, tractor-type plows are much more effective than jeep plows in certain types of woods and terrain, although the mobility of the jeep unit outweighs this advantage at times. Use of the tilt-bed truck makes up for this lack of mobility on the part of the tractor plows and increases their usefulness over a very large area.

Many representatives of the forest services of other States have witnessed demonstrations of the tilt-bed, and whenever demonstrated, it has aroused much interest and enthusiasm. Several States are now considering including the tilt-bed as part of their standard forest fire fighting equipment.

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Smoker Fires Decrease In British Columbia

During the past decade there has been a significant decrease in the number of fires caused by smokers in British Columbia. Data taken from Annual Reports of the British Columbia Forest Service show that for the 10-year period 1944-53 smoker-caused fires dropped from 20.52 percent of fires from all causes in 1944 to 12.04 percent in 1953. This gave a yearly average of 18.05 percent for smoker-caused fires.

Ian Cameron of the Protection Division of the British Columbia Forest Service states that so far as he knows there has been no change in classification of fire causes. He attributes the decrease in fires caused by smokers to the expanded program of public education in British Columbia, the rest of Canada, and the United States.

The downward trend for the decade is just significant at the 5-percent level of probability. It is interesting to note that the predicted percentage of smoker-caused fires for 1954, 15.5 percent, agreed very closely with the actual percentage for 1954. By November 1954, 118 of the Provincial total of 763 fires, i.e. 15.47 percent, had been caused by smokers.—J. HARRY G. SMITH, *Assistant Professor, Faculty of Forestry, The University of British Columbia.*

LIGHTWEIGHT SLIP-ON PATROL TANKER

ARCADIA EQUIPMENT DEVELOPMENT CENTER

California Region, U. S. Forest Service

Most fire tankers are designed to utilize the full capacities of a vehicle. Such units provide maximum service for fire fighting, but leave little room in a pickup truck to haul equipment and materials. There has been a need for a low-cost small fire fighting unit that can be mounted on pickups used by patrolmen, recreation guards, etc., leaving ample room for hauling the variety of items necessary in field operation. This includes drums of gas, personal belongings, miscellaneous tools, directional signs, posts, garbage cans, etc.

As a result of field requests for such a tanker, the design problem was assigned to the Arcadia Equipment Development Center. A lightweight, slip-on tanker has been developed, and 18 units are now undergoing field-service test in the California Region. The unit consists of a 50-gallon water tank on which is mounted the reel and pumper (fig. 1).

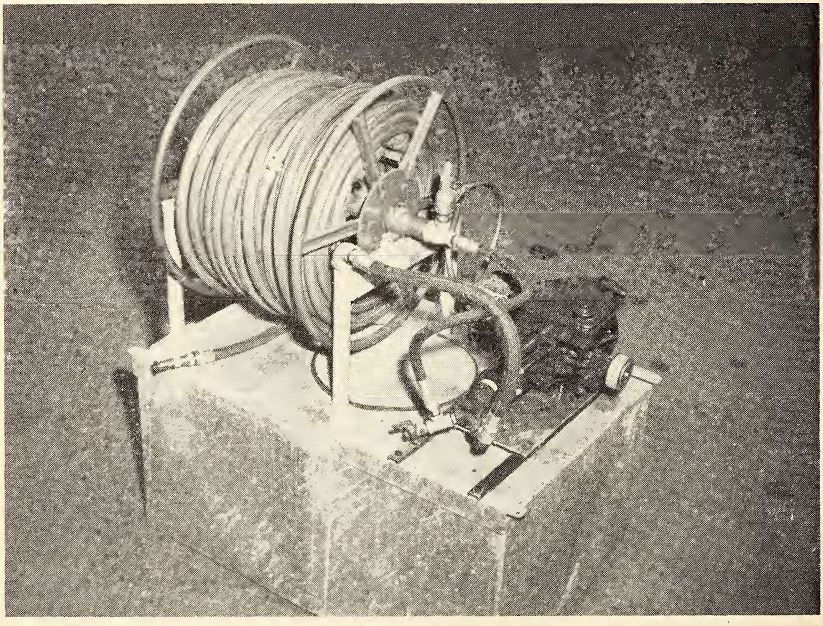

FIGURE 1.—Base dimensions of tank, 36 by 24 inches; height to top of reel, 40 inches; tank capacity, 50 gallons. Inside dimension of reel, 13 by 23 inches; core, 10 inches; reel capacity, 200 feet of ¾-inch hose. Total weight of unit when filled with water, 640 pounds.

The tank measures 36 by 24 inches and is 14 inches high; it is constructed of 14-gage steel, includes a baffle, and is galvanized to prevent corrosion. A large cleanout hole is provided as well as a 2-inch fill opening and a 1-inch drain.

The pumper unit weighs 26 pounds and consists of a small, positive displacement pump that is driven by a 1.6-horsepower gasoline engine. Actually, the engine is the same as those used on some lawn mowers. The pump is rated at 7½ gallons per minute at 150 pounds per square inch and, as with the engine, was borrowed from commercial application. Pumps similar to these are now used in aircraft hydraulics and are under consideration for use in automotive power steering. It has no connecting rods, gears, springs, cones, or clutches, and only one point for occasional lubrication. Only one manual valve is included with the outfit. It is of the small petcock type which is opened for priming.

The characteristics of the pump and the design of the suction side are such that draft from overboard with the usual suction hose is not recommended. For filling the tank from draft, a small ejector should be used. Details of suitable ejector for this purpose are given in U. S. Department of Agriculture, Forest Service, Equipment Development Report No. 20, Water Ejectors.

The live reel standards are made of 1-inch pipe and extend into the tank. The two pipes near the pumper extend to within ½ inch of the bottom and serve as suction line for the pump and discharge line for the relief valve. The other two pipes serve as vents.

A garden-type nozzle is used on these units which provides means for shutoff and spray adjustments. During shutoff, the relief valve permits the full discharge to return to the tank.

Further information can be obtained by writing to the Arcadia Equipment Development Center, U. S. Forest Service, P. O. Box 586, Arcadia, Calif.

RADIO MAINTENANCE COST ANALYSIS

MAX GUIBERSON

Radio Engineer, State of Washington Division of Forestry

In this competitive and price-conscious era, it has become increasingly necessary that accurate, complete cost records be maintained in both private and public industry. A breakdown on costs of the communications facilities of the State of Washington Division of Forestry for the fiscal year ending April 1, 1953, showed the average maintenance cost per month of a headquarters radiophone to be $7.51; a mobile, $6.45; and a lookout, $9.78. Depreciation of the radios, truck expense, meals, lodging, office expense, and all other expenditures necessary for the operation of the communications section are included in these costs. While the figures are based on a 12-month year, the majority of the radios are in use approximately 7 months.

The various radios owned by the Division of Forestry are distributed among 21 forestry districts within the State of Washington, with each district assuming the maintenance cost of radios assigned to it. As in many other departments, most of our purchases of parts are made in quantity once a year, and are achieved by submitted bids. When the parts are received in our stockroom, each item is checked and entered in a master-inventory record book.

The radio technicians of the Division of Forestry communications section maintain individual, less comprehensive stocks that are obtained from the main stockroom. When parts are issued to a technician, the stock clerk fills out a sales check, a copy of which is given to the technician for his reference. The original sales check is kept by the stock clerk for use in transferring items from the master-inventory record book to the technician's inventory record book; it is then filed numerically with the stockroom records.

Each technician is assigned an individual workbench for radio shopwork, and a State panel delivery truck to be used for field maintenance. The workbenches have cabinets with drawers for storing radio parts. When field maintenance is necessary, these drawers can be used in a similar cabinet permanently installed in the technician's truck, permitting safe conveyance of fragile radio parts to the field.

After a technician services a radio, he fills out a triplicate sales check showing the various parts used. He retains a copy for reference and gives the stock clerk the original and duplicate. The duplicate copies are sent to the districts as supporting detail for monthly billing. The originals are used by the stock clerk for removing from the technician's inventory the items listed on the sales check, and for other bookkeeping purposes, after which they are filed numerically with the stockroom records. From maintaining the technicians' inventory records, the stock clerk is familiar

with the items in the technician's stock, and there is little chance of a technician making a field maintenance trip without adequate parts for repair of the radios involved.

Since a file folder containing completed maintenance record forms and a master cost card is kept for each radio, a complete history of each radio, from the time it was put into service, is available. The information shown includes the nature of the trouble reported; repairs that were made to correct it; frequency measurement, in compliance with FCC rules; the number of the sales check listing the parts used; and the total hours of labor necessary to repair the radio. These complete individual maintenance histories, available to each technician, ensure more adequate servicing.

When the cost of maintaining individual radios is known, it is a simple matter to prorate the balance of the communications section expenses among the radios and arrive at the cost per radio of maintaining the communications network. Although our record system has been in use for only a few years, it has proved to be an accurate method of controlling the various large and small items of stock necessary to such an enterprise, all of which contribute to the overall cost.

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Canteen Gaskets

On the basis of an employee suggestion by Jack Shumate of the Coconino National Forest, Southwestern Region, the Arcadia Equipment Development Center has the following to say with regard to canteen gaskets:

> Past use of paper and cork canteen gaskets has long indicated a need for consideration of other materials. Mr. Shumate's suggestion for utilizing inner tube material, preferably of the synthetic type as noted, is certainly a practical method for obtaining gaskets at locations or under emergency conditions where supply problems are involved.
>
> However, after a survey of local warehouses, we were informed that rubber gaskets are being purchased separately for installation in all canteens, both old and new, at a cost of approximately 4 cents apiece. In the interest of economy and of obtaining a uniform product it is felt that commercial procurement would be the more satisfactory method. They should be purchased as "Gaskets, neoprene, medium Shore Durometer, ⅞-inch i.d. x 1½-inch o.d. x ⅛-inch thick." These gaskets generally have an average hardness of 50-55 Durometer.

Perhaps we have seen the end of the irritating, leaky canteen.

HOW CORBIN, KENTUCKY, GOT A COOPERATIVE FIRE-SUPPRESSION ORGANIZATION

Earle H. Meekins

District Ranger, Cumberland National Forest

Gaining cooperation in forest fire suppression work has been an objective of private, State, and Federal agencies since the first attempts to protect the forest resources from wildfires. During the 1952 fall forest fire emergency in eastern Kentucky, a group of public-spirited sportsmen talked seriously about the situation. They decided that sportsmen had a primary interest in forest protection and that they should offer their help in the emergency. As Cyril Fields, sporting-goods store owner termed it, it was a cracker-box organization formed by retired railroaders, weekend hunters, newspapermen, a jeweler, and other interested people.

The first fire they hit with any strength was the one on Arches Creek in the Jellico District, Cumberland National Forest. Two volunteer crews came to this 1,172-acre fire in their own cars to give a helping hand. The 30 men drove about 25 miles, much of it over rough dirt roads, to man the firelines.

Following this first volunteer effort by untrained but willing workers, the organization grew. During the winter, several meetings were held by the key people and a formal organization was developed to meet fire and flood disasters. The newspaper and the radio station were asked to give spot news and send out calls for help during emergencies. Available equipment, transportation, food, blankets, and first-aid supplies were to be listed on three sets of cards. Volunteer help was also to be listed for dispatching.

Out of the 520, or so, members of the Rod and Gun Club, the officers believed that at least 100 would turn out for emergencies. The plan provided for a disaster organization to cooperate with the Red Cross. Special equipment, including tools, would be supplied by State and Federal agencies.

When the second dry fall, that of 1953, rolled around, Fields, Distad, and other leaders in the movement found that calls for help on forest fires were becoming frequent. The word soon spread by word of mouth and radio that there was a new forest fire fighting outfit at Corbin. What started out to be an emergency organization was becoming a frontline, volunteer, forest fire fighting unit available to anyone who had an uncontrolled fire. Soon many business men found that when they fought fire all night they were unable to perform their normal quota of work the next day. The cooperative effort suffered, as did the morale of the group, and many of the older men did not respond to fire calls in November.

During the spring of 1954, the movement away from the organization continued until only a half dozen of the older men of the original fire fighting group were left. Fields and Distad stayed.

As the older men dropped out of the organization, they were replaced by Junior Conservation Club members who were high school juniors and seniors.

From the fall of '53 through the spring of '54, the organizational record shows that it fought 23 forest fires (14 in Knox County, 6 in Whitley County, and 3 in Laurel County). Of these, 19 were fall fires, and 4 spring fires. There were 148 man-trips, 603 hours on fires, and 770 miles driven. Of the 23 fires fought, 2 were on national-forest lands, the remainder on private lands. No division was made in the organizational records between those which were State fought and those which were private.

Payment to fire fighters has been on a voluntary basis. The United States Forest Service paid the fire fighters, since it paid other emergency fire fighting personnel. Some of the men turned their fire fighting earnings over to the parent organization as donations.

What of the future? According to Fields, the Fowler Club—an 18-man volunteer firemen's club at Corbin—will take over the burden of leadership. The members are all young men who enjoy the adventure of town and forest fire fighting. They are at present remodeling a 4-wheel-drive command car for forest fire fighting, flood emergencies, and use on other jobs where the going is rough. These 18 members of the Fowler Club, plus 6 especially interested members of the Rod and Gun Club, are to take over the leadership positions during forest fire emergencies. According to Fields, they will take over the sectors, communications, scouting positions, and services of supply when needed.

Leaders of the emergency unit insist on two provisions: (1) The protection organizations shall not depend on it except in a case of real emergency, and (2) if other forest fire fighters are paid, the men in their organization shall be too.

The Jellico District has planned a training program for the 24 leaders; it will include motion pictures, discussions, and a field demonstration. Although the training will not turn out finished fire fighters, it should serve to acquaint these men with the duties and responsibilities of leadership and how the organization on a large fire works as a team.

YOUR GUARD STATIONS: HAVE THEY BEEN EQUIPPED WITH EXTERIOR EMERGENCY TELEPHONES

A/1c E. M. PARK

Fire Prevention Section, 77th Installation Sq.
Long Beach Air Force Base

Whenever a fire call "hits" at one of your stations, or when one of your patrolmen leaves his quarters to begin his rounds, does your protection agency still follow the outdated procedure of hanging a "Ranger Out" sign on the front porch, leaving the premises locked up, and simply trusting good fortune to carry on from there?

While it may seem offhand that there is nothing particularly wrong with this course of action, stop for just a moment and think: what would happen if a forest inhabitant, suddenly finding himself in need of immediate emergency communication with "the outside," hurried to your station and discovered a locked door and sign reading "Ranger Out"—In case of emergency use phone at Dugan's Mill, 7 miles south of here."

This writer is personally familiar with no less than three instances in which medical aid was delayed in reaching forest occupants suffering from personal injuries. In each case the hindrance was due to an identical cause: the person who discovered the accident went to the nearest guard station to summon assistance but found a locked building and no means of calling for help. Of course, one might conclude that an instance of this nature is a personal matter and of no direct concern to a fire protection agency. This is a shaky conclusion, because the same circumstances could apply to a fire situation. What happens then? Would it be necessary for the person discovering a blaze to "use phone 7 miles south" of the guard station, with a resulting delay in alarm transmittal?

Why make it necessary for a person to waste vital minutes in traveling to a distant instrument when an exterior telephone extension, exclusively for the emergency use of forest users, can be easily and inexpensively installed. Such phones have been in use for many years at mountain stations of the Los Angeles County, Calif., Fire Department. A typical exterior phone installation is shown in figure 1. Notice especially that it is placed in as prominent a location as possible—directly at the main entrance to the station. Observe also that the callbox is painted in sharply contrasting colors—aluminum body with red or black letters, and that all lettering is large enough to be read at a distance. Special attention is also directed to the yellow-and-black sign mounted above the callbox. Here, reflecting paint is used, which lights up brilliantly when vehicle headlights are directed toward it at night.

FIGURE 1.—A carefully planned emergency telephone installation. Notice that regardless of your direction of approach toward this callbox, its purpose is instantly understandable.

Inside the box, in a conspicuous place, is a concise but complete set of telephone operating instructions. This may seem to be of minor importance; however, it is well to keep in mind that a magneto-type telephone may be confusing to some people. Making it easier for forest users to communicate with "the outside" during times of emergency can mean the difference between life or death, a prompt fire report or the catastrophe of a delayed alarm.

COALMONT'S VOLUNTEER TRAILER-TANKER FIRE FIGHTING UNIT

JOSEPH S. DEYOUNG

Forester, Indiana Department of Conservation

A group of trained volunteer forest fire fighters in the small town of Coalmont, Ind., spearheaded by a part-time fire warden and a garage owner, built a unique forest fire fighting unit (fig. 1). It consists of a trailer with tanks and power pump, and carries enough fire fighting equipment—rakes, beaters, axes, shovels, back-pack pumps, first-aid kits and water canteens—to outfit a crew of 20 men. This unit is thought to be the only trailer-housed piece of forest fire fighting equipment owned and constructed by volunteer forest fire fighters.

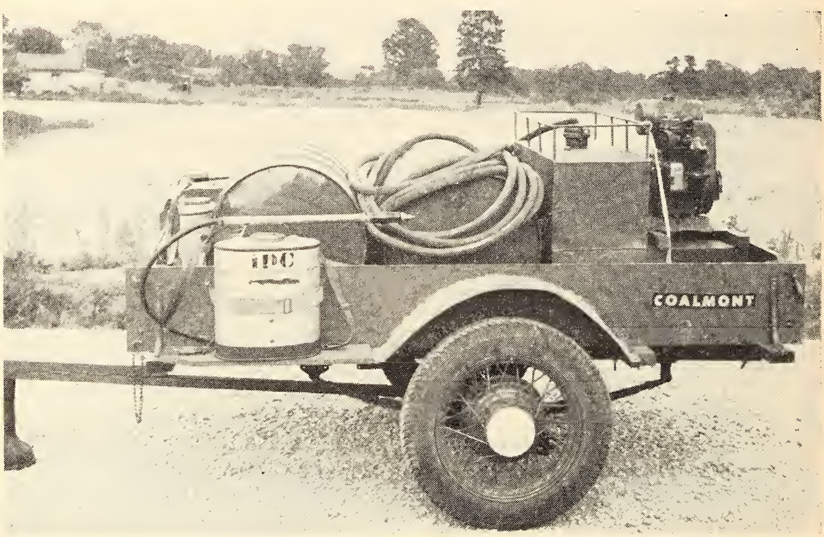

FIGURE 1.

The trailer-tanker was made from salvage material. The State provided an old surplus water tank and a Panama pump that was rebuilt and reconditioned. All the labor, including welding, was donated by members of the group. The water capacity of the tank is 205 gallons. The trailer is painted bright red, and has the name "Coalmont" printed on its sides. Fire fighting equipment is carried on the trailer at all times.

Coalmont's forest fire fighting unit, manned by local volunteers, is ready at all times to make runs to suppress outdoor fires and to fight building fires; the town does not have a fire department. The cars and trucks of all the volunteer fire fighters are

equipped with trailer hitches, so that the first man to reach the trailer is able to take it to the scene of any fire. This efficient group has appreciably reduced the size of the average outdoor fire in its area.

The efforts of these civic-minded citizens and their active interest in forest conservation should be an inspiration to conservationists in other communities who may wish to equip themselves in a similar manner for forest fire fighting. The Coalmont volunteers deserve great credit for their worthwhile project.

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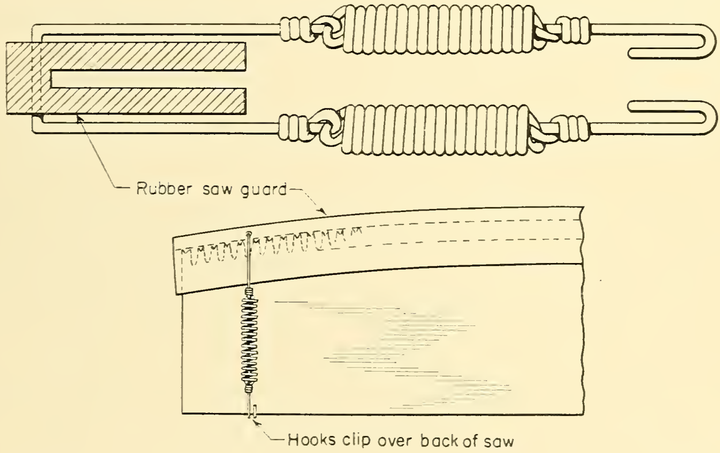
Simple Saw Guard Fastener

This simple, economical clip for fastening rubber guards to crosscut saws is made from ordinary door spring and number 12 wire. This type of rubber guard is often wrapped with rope, wire, or tape to hold it to the saw. The clips are faster, simpler, safe, and cheap.

Each clip consists of two sections of spring about 1½ inches long and 3 pieces of wire fabricated as follows:

A length of wire about 10 inches long is passed through a hole in the rubber guard to the midpoint of the wire. Both ends are then bent as shown and fastened to the coil springs. Excess wire is cut off. Then a hook is formed with another piece of wire and fastened on the other end of each spring.



The type and size of saw determines the length of wire needed for the hooks. About five clips are needed on a 6-foot saw. Two screen door springs cut into 1- to 2-inch lengths are ample for one saw guard.—W. D. BROADHURST, *Fire Crew Foreman*, and D. H. EULER, *District Ranger*, *Modoc National Forest.*

ATTACHING FIRE-HOSE COUPLINGS

Robert St. J. Orr.[1]

Probably no subject in the field of fire-fighting equipment has received less attention than the attachment of expansion ring-type fire-hose couplings. The old proverb that "A chain is as strong as its weakest link" applies most truly to fire-hose couplings. The entire layout of pump, hose, and nozzles may be rendered useless if an improperly attached coupling blows off the hose while in service on a fire. Yet a correctly designed expansion-ring coupling, properly attached, will definitely withstand the bursting pressure of the hose for which it was designed.

Equipment and Material

In approaching this subject, let us first consider the basic equipment and the mechanical principles involved.

Expanding tools.—These are made in two types, hand operated and power operated. Hand-operated types are usually adequate unless constant use justifies investment in a power-operated machine. They are made in individual sizes, ¾, 1, 1¼, 1½, 2, 2½, etc., up to 4½ inches, and can only be used on hose of corresponding inside diameter, disregarding outside diameter entirely. Basically, this machine consists of a drawbar, threaded at one end, tapered at opposite end and mounted in a heavy cast bronze housing provided with a thrust bearing. A set of segments consisting of 8 to 12 individual tool-steel sections forms a collar at the tapered end of a drawbar. The expansion ring fits over these segments and is expanded as the tapered part of the drawbar is drawn into the housing by the machine. An adjustable spacing gage is provided on the housing; adjustment of this permits placing the ring in an exact, predetermined distance inside the coupling. Because this tool is subjected to severe stress, only tool-steel segments are adequate to produce reliable performance.

Couplings.—These are usually provided in sets consisting of one male with external thread, and one female with internally threaded swivel connection. Both are provided with a hose bowl that must fit snugly over the outside of the hose, or not be more than 1/32 inch larger than hose. The interior of the hose bowl is machined next to the throat of the coupling to provide a suitable seat for the hose-bowl gasket, and the balance of the interior is provided with circular serrations that grip the hose when the expansion ring is installed. The throat or waterway through the threaded part of the male coupling must at all times equal the inside diameter of the hose—except on special reducing or increasing couplings.

[1]General Manager of the Western Fire Equipment Co. This is an abridgement of an article of the same title that appeared in Forester Fire Equipment Notes, and is published here by permission of the Western Fire Equipment Co.

First-grade couplings will pay dividends in service if properly attached. They are usually made of red brass (80 to 85 percent copper alloy), and are designed to grip the hose securely. They are uniformly machined and must fit the hose accurately. Poor couplings, made of yellow brass, will often stretch freely as the ring is expanded; this may cause them to blow off under high-pressure service. The interior serrations must be uniform, of adequate depth, and with fairly sharp edges to securely grip the hose. Uneven serrations obstructed by core-sand or miscast are sure to cause trouble. All machined dimensions in couplings of the same size, type, and manufacture should be uniform.

On male couplings, the distance from face of male thread through the waterway to seat of hose-bowl gasket should not vary materially. This measurement is used to set the spacing gage on the expanding tool in relation to the expansion ring. Consequently, serious variation causes the ring to lodge in the throat of the coupling or too deeply in the hose bowl. Female couplings may differ from male couplings in measurement at this point, but should otherwise be uniform. The waterway in both male and female couplings should be at least 1/64 inch larger than nominal inside diameter of hose to permit free entry of the expansion ring. Secure attachment of even the finest couplings is impossible if the hose bowl is too large in diameter. This is especially true on ¾- or 1-inch high-pressure hose. Normally, the hose should enter the hose bowl with only slight assistance, never very freely. A tight fit is preferable to a loose one. Since expansion ring couplings are made in various diameters, weights, and lengths, and with many different threads, and are equipped with several different styles of spanner lugs on the female swivel, when ordering couplings only, the outside diameter of hose to which they are to be attached must be considered.

Hose.—Hose varies according to service and performance requirements. Unlined linen hose, rubber-lined cotton-jacketed hose, and rubber-covered hose differ in materials and design. They are broken down into various types: Commercial linen hose and mildewproof linen forestry hose; single, double or triple cotton-jacketed rubber-lined hose; wrapped, braided or woven, rubber-lined rubber-covered hose; also circular woven or wrapped wire reinforced-suction hose. The inside diameters are made to nominal standards of almost any dimension (1, 1½, 2 inches, etc.), but these have no relation to the outside diameter. For instance, linen hose of 2½-inch inside diameter usually measures 2-11/16 inches outside diameter, whereas cotton-jacketed 2½-inch hose may measure up to 3¼ inches outside diameter and 2½-inch suction hose as much as 3½ inches outside diameter. Therefore, the hose bowl of the couplings must match the outside diameter of the hose to which they are to be attached, and the waterway of couplings must match inside diameter of hose. Hose designed for high pressure such as double cotton-jacketed hose must be provided with couplings designed for use in similar service. These are of heavier construction with longer hose bowls and longer expansion rings than those used on low-pressure hose.

Expansion rings.—These are made of special composition copper base alloys with ductile characteristics permitting 40 percent expansion above original diameter without breakage. A minimum wall thickness of 0.050 inch is essential in 2-inch and smaller diameters, and 0.062 in 2½-inch sizes with corresponding increases in larger sizes. The length of rings required is determined by depth of coupling hose bowl on which installed. At no time should the ring project beyond the end of the hose bowl, as it will tend to shear the hose at that point. Usually, the ring should be ⅛ inch shorter than the hose bowl and free of any sharp edges that might cut the inside of hose. If one edge is beveled at a 45° to 60° angle, it will facilitate installation, especially when hose diameter is contracted by very tight-fitting couplings.

Hose bowl gaskets.—These serve to prevent leakage behind the expansion ring or between layers of rubber and fabric. They are not needed and are of no value when coupling unlined linen hose. Neither are they required for use on rubber-lined rubber-covered hose *if* the hose ends are securely sealed with vulcanized rubber by the manufacturer so that not a single strand of fabric is exposed. Their use is definitely imperative on all rubber-lined rubber-covered hose with *fabric exposed at the ends.* If omitted, water will seep into the fabric between the rubber lining and rubber cover, forming blisters on outside of hose that will rupture the rubber cover. They are likewise essential to prevent leakage at couplings on all cotton-jacketed rubber-lined hose. These gaskets are made of medium-soft rubber, free of any fabric. They are lodged in the end of the coupling hose bowl adjacent to the throat, where a machined seat is provided. Their inside diameter is 1/16 inch larger than the nominal inside diameter of hose on which used. Thickness of gaskets varies from 3/16 inch for hose of ¾- to 1½-inch inside diameter, to ¼ inch for hose of 2- to 4½-inch inside diameter and ⅜ inch for 5-inch or larger hose. The outside diameter depends entirely on the diameter of the gasket seat provided inside the coupling hose bowl. This dimension has never been standardized by any manufacturer and is not governed by any rules; *it must be* measured and the gaskets fitted. Gaskets of too small inside diameter will obstruct passage of the expansion ring and make coupling difficult or impossible. If too resilient, they may be squeezed out by the expansion ring. If too small in outside diameter, they will not seal.

Supplemental Equipment

The following items should also be provided. They are essential to satisfactory work.

1. A standard 6-inch long machinist's steel rule calibrated in 32ds for measuring hose bowls and setting spacing gage.
2. An 8-inch spring type inside caliper, for measuring the diameter of hose bowl gasket seats.
3. A "rubber worker's knife" with 8-inch long straight-edged blade, for cutting hose ends accurately.

4. A medium-grit carborundum sharpening stone 6- to 8-inches long, for sharpening knives. When cutting high-grade rubber, a sharp knife is imperative.

5. Make up rubber lubricant consisting of a concentrated soap solution. Use ½ cake of soap, or equivalent, to 1 quart of warm water. Cut soap into shavings and stir into water until dissolved. Add water from time to time if necessary.

6. A small paintbrush, about ½-inch round, for applying rubber lubricant.

7. A hose test pump, if no other means is available, for adequately testing high-pressure hose (150 pounds or more working pressure).

Use of Expanding Tool

1. Check expanding tool to see that drawbar is fully extended so that segments can collapse to smallest possible diameter.

2. If drawbar is dry, lubricate with a very small amount of heavy cup grease, especially underneath the segments. Wipe off any excess grease; it may damage rubber-lined hose.

3. Select expansion ring of proper length for the particular coupling and with beveled edge outward, fit it over segments till it lodges against shoulder. Operate expander until *very light* tension is exerted by segments to hold ring firmly in position—about ⅛ to ½ turn.

4. Place coupling on machine and note where it contacts spacing gage. Point of contact will differ between male and female couplings. Remove coupling and measure *accurately* the distance from shoulder, where hose bowl gasket lodges, to outer face of thread that contacts spacing gage on expanding tool. Add 1/16 inch to this measurement for all couplings of 2½ inches or smaller inside diameter, 3/32 to ⅛ inch for larger couplings. Now set spacing gage on expander to this exact distance, measuring from nearest edge of expansion ring to point where coupling previously contacted spacing gage. Because this measurement can be more easily determined on the male coupling, it is best to attach that coupling first. Repeat same procedure for female coupling, but note that contact point is different on spacing gage to compensate for greater length of female coupling. Adjust spacing gage if necessary.

5. Examine end of hose to be sure it is cut cleanly at 90° angle to its length. Frequently it is necessary to trim off loose ends on linen or cotton-jacketed hose. Usually, a clean end can be obtained by cutting off an inch or two completely, but this should never be done with rubber vulcanized ends—it might expose the fabric.

6. Fit the hose-bowl gasket into gasket seat provided at forward end of hose bowl. Then place coupling onto hose and work it down until it seats against hose-bowl gasket. Examine carefully inside to see that hose is properly lodged and beware of any loose strands of thread that may project into waterway; they will act as wicks for seepage if not cut off.

7. Fit hose and coupling assembly over expander drawbar and force into position over expansion ring until face of coupling contacts spacing gage. In doing this, grasp the hose, *not* the coupling,

to prevent dislocation of the hose in hose bowl. Do not twist, but exert steady pressure until properly seated.

8. Begin expanding by turning expanding tool clockwise. Note *carefully how tension increases;* this "feel" is the primary means of determining degree of expansion. Number of revolutions will vary according to wall thickness of hose. Usually at some point between 10 and 15 revolutions a sudden increase in tension will be noted. This indicates that the hose has been compressed and that the coupling now provides resistance to expansion. Proceed slowly one or two revolutions and carefully examine outside of hose bowl on all sides for any distortion. Such distortion will be preceded by "sweating" of the metal, which is easily recognized on polished couplings but difficult to detect on unpolished ones. It will be recognized by the appearance of minute ripples on the surface of the hose bowl. Do not apply further tension if sweating is noted, as this will break the coupling or render it useless by distortion. Count the number of revolutions as you reverse the expanding tool to starting position. This will help you in gaging the tension required for attaching next coupling of same type and size. Examine inside of hose carefully to see that expansion ring is lodged directly adjacent to waterway. If properly expanded, it will bury itself in rubber-lined hose to a point where inside diameter of ring about equals inside diameter of hose—on hose with heavy walls to a greater extent, and on linen hose to a lesser extent. If ring shows inadequate expansion, replace on machine and apply additional pressure, proceeding cautiously. If any part of hose-bowl gasket has been forced out into waterway, trim this off with small sharp knife, being careful not to injure interior of hose. Remember that use of the expanding tool will be facilitated by experience and by learning to "feel" the tension applied.

9. Test hose after coupling if at all possible by subjecting it to at least the normal working pressure at which it will be used—preferably test to 25 percent beyond maximum working pressure to which it may ever be subjected if you have means of applying such pressure. Couplings attached by novices and not pressure-tested may blow off in service.

Correcting Troubles

Expansion ring will not fit over expander segments.

1. See that drawbar is fully extended.
2. Examine for dirt that spreads segments apart; disassemble and clean with kerosene; grease and reassemble.
3. Excessive use without lubrication has created burrs on sides of segments; disassemble and carefully remove burrs with fine-tooth file; grease and reassemble.
4. Ring may be substandard on inside diameter.

Expansion ring is lodged in throat of coupling or too far into hose bowl.

1. Inaccurate measurement of coupling or in spotting space gage.
2. Ring was moved out of position when coupling and hose assembly was forced over it.

Hose-bowl gasket projects into waterway and prevents fitting of coupling and hose assembly onto expanding tool.

Remove hose from coupling, leaving gasket in hose bowl, and trim inside of gasket to full diameter of waterway, using a razor-sharp knife.

Hose fits too loosely into coupling hose bowl.

Replace coupling with one that fits properly; there is no other *safe* correction.

Hose too large to enter hose bowl.

Action depends on how much too large. 1/32 inch on small hose and 1/16 inch on large hose can be overcome by lubricating the inside of hose bowl with an ample quantity of rubber lubricant (see Supplemental Equipment, No. 5, above). Also, apply lubricant freely to hose on inside, outside, and at end. Clamp coupling in a vise to hold securely while forcing hose into bowl.

Hose will not fit over expansion ring.

1. Apply ample rubber lubricant to expansion ring while mounted on expander; also to inside of hose.
2. Be sure that a restricted hose-bowl gasket is not the cause.
3. On rubber-lined hose, trim edge of inner tube with a sharp knife to a 45° to 60° angle.
4. Remove ring from expander; place hose and coupling assembly in position on expander; apply expander pressure *moderately* to stretch hose and force it into position in hose bowl. Remove hose assembly; replace ring on expander and proceed as usual.

Expansion ring breaks before it is fully expanded.

1. Due to poor quality of product or annealing.
2. Rubber-covered hose with wall thickness of ⅜ inch or more, if very resilient, may permit excessive expansion of ring. Remove broken ring and start again; proceed until ring is about ¾ inch expanded, just before point where previous ring broke. Remove hose and install a second ring, proceeding as before. Then expand both rings simultaneously. If outer one breaks, it will serve as a space filler and inner ring will hold. Be sure to apply pressure test to hose after coupling.

Linen hose shows broken strands directly adjacent to coupling.

Coupling is too large for hose. Linen hose is not resilient. Use coupling with snug-fitting hose bowl.

Reattaching used couplings.

They should be examined first to determine whether they are in good condition. To remove old expansion rings, cut hose off directly adjacent to hose bowl, then drive a 10- to 12-inch solid-shank screwdriver between the ring and the hose. Drive down two-thirds the length of ring, then bend ring toward center and kink same. Avoid damage to coupling by careless use of tools. Clean all remnants of old hose out of hose bowl. Check threads to see they are not damaged. Examine swivel on female coupling to be sure it turns freely. If it does not, examine for dirt and clean if required. If it still binds turn to point where it binds, locate point, and strike swivel 3 or 4 sharp blows with wooden mallet while holding coupling in one hand.

The above information should enable an average person with a little mechanical experience to perform a satisfactory job. It should be carefully studied to prevent damaging couplings through careless use of the expanding tool. As experience is gained, handling of this work will be greatly facilitated.

Salvaging fire hose that has been discarded because of physical injuries or damaged couplings will pay substantial dividends. Most organizations that have several thousand feet of fire hose in service also have damaged hose on hand that is out of service. Present high costs of hose and couplings will probably justify the cost of necessary repair tools. Please feel free to call on our Engineering Department for any information or assistance we can render in connection with hose and coupling problems.

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Published Material Of Interest To Fire Control Men

Burning Techniques and Crew Organizations, by T. A. Coates. Brit. Columbia Lumberman 38 (7) : 95-96, 98. 1954.

Forest Fire Fighting Equipment, by E. L. Howie. Pulp and Paper Mag. Canada 55 (10) : 154, 157, 159-160, 163, illus.

Ontario Uses Helicopters to Aid in Forest Fire Fighting and Protection, by Ontario Department of Lands and Forest. Pulp and Paper Mag. Canada 55 (10) : 164, 167-168, illus.

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Maintaining an Effective Organization to Control the Occasional Large Fire, by M. H. Davis. Jour. Forestry 52: 750, 753-755. 1954.

Early Fire Protection Insures a 50-Year Partnership in Forest Research, by N. R. Hawley. AT-FA Journal 16 (12) : 4-6. 1954.

Will Forest Fire Insurance Work?, by H. B. Shepard. Amer. Forests 60 (10) : 20-21, 47-49. 1954.

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The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed in the manuscript immediately following the paragraph in which the illustration is first mentioned, the legend being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

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FIRE CONTROL NOTES

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

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The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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Forest Service, Washington, D. C.

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CONTENTS

TRACTOR-BORNE RADIOS

James E. Mixon

State Forester, Louisiana Forestry Commission

The Louisiana Forestry Commission has adapted a standard, two-way, commercially available radio to tractor mounting and is now conducting tests of the device.

At present, all radios handled by forest fire fighters are attached to trucks that haul the tractors to the fire scene. When the crew wants to get in touch with the towerman or someone else to summon help on a fire, one man has to walk back to the truck. This loses precious time and timber. Also, there is no way to contact the man actually driving the tractor on a fire to give him directions.

Communications Engineer Al Vendt and his radio technicians have been working on the tractor-borne radio, ironing out wrinkles in its operation. Experiments with a tractor in Rapides Parish proved so successful that tests have been enlarged.

The radio is fixed to the fender of the tractor in a special weatherproof and practically destruction-proof, 10-gage steel cabinet for protection against the rugged conditions of the fire-line (fig. 1). All control heads and the microphone are also in

Figure 1.—Radio cabinet attached to tractor fender.

weatherproof and snagproof cases, to insure minimum damage to the equipment. Four bolts hold the entire assembly onto the tractor fender and one wire is all that is needed to connect it to the tractor battery. The antenna is mounted on the case.

For maximum efficiency, an extra set of controls is installed in the cab of the truck. With this arrangement, the radio can be operated either from the truck or tractor battery. While riding in the truck, the crew operates the radio from the truck battery. On arrival at the fire scene, they unplug the truck connection and plug in the tractor cord. The system is fixed so that the tractor motor won't start unless the truck cord is unplugged.

If the tractor-borne radios continue to prove as successful as in the first tests, the Louisiana Forestry Commission plans to have all its tractors equipped with two-way radios.

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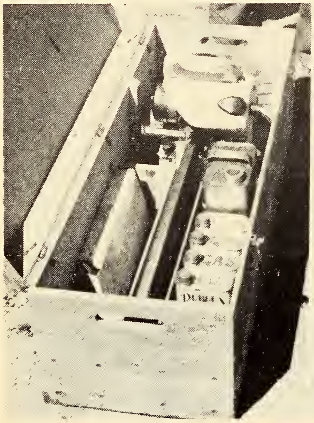
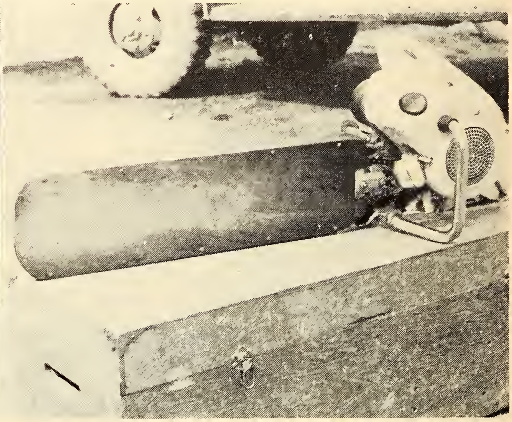
Box and Blade Sheath for Chain Saws

No doubt boxes for chain saws are in common use. However, this article is submitted with the hope that it may contain some features worth passing on. Scale drawings are not included because each make and model of saw requires a box of a different size.





This box is made of plywood, ¾-inch for the ends, and ⅜-inch for the bottom, top, and sides. It is assembled with screws, and quarter round is used for cleats. The corners are reinforced with brass chest corners. Separate compartments on the inside, one at each side of the saw blade, accommodate gasoline, oil, spare parts, tools, and instruction book. The sheath for the blade consists of two pieces of ¼-inch plywood separated on top and bottom with strips of wood slightly thicker than the width of the chain. The sheath is bolted together. Both ends are open to facilitate the removal of chips or other foreign objects. It is easy to use and offers maximum protection to the saw blade and chain.—Glenn E. Brado, *District Ranger, Sawtooth National Forest.*

EFFECTS OF PRESCRIBE-BURNING 4-YEAR-OLD PLANTED SLASH PINE

W. F. MANN, JR., and L. B. WHITAKER

Alexandria Research Center, Southern Forest Experiment Station

In the winter of 1952-53, a prescribed fire was successfully used in a young slash pine plantation in central Louisiana. Mortality of the burned pines was light and height growth was not seriously retarded. The main object of the burn was to reduce the depredations of free-ranging woods hogs, which had damaged the stand the previous summer. From this standpoint the results were encouraging but did not provide a final answer. A second purpose in burning was to reduce the heavy fuels on most of the area.

STUDY AREA AND METHODS

The study was made in La Salle Parish, where the Nebo Oil Company has extensive young plantations of slash and loblolly pine. The idea of using fire developed in the summer of 1952, when hogs severely damaged the stands by stripping the bark from the main stems and digging up lateral roots. For example, in one 2-year-old slash pine planting, hogs killed 52 percent of the seedlings and injured another 23 percent. Mortality in a loblolly plantation exceeded 60 percent. In contrast, no hog damage was found on several small areas that had been burned by a wildfire the previous winter.

To determine the effects of fire, a 4-year-old slash plantation was selected for a large-scale trial in the winter of 1952-53. This stand averaged 565 pines per acre. Trees ranged from 2 to 11 feet tall, and averaged about 6 feet. The area had been grazed by cattle. As a whole, grazing had been moderate, but there were some small areas where the grass had been cropped too low to carry fire, while other areas had been grazed lightly. Even on heavily grazed portions, the grass was tall and dense beneath each tree.

A total of 600 acres was burned between January 24 and March 4, 1953. The area was divided into units of 15 to 50 acres by plowing extra firelines to supplement the permanent firebreaks. Because time was limited, it was necessary to burn under a variety of fuel and weather conditions. However, fires were always set against the wind, which ranged in velocity from 7 to 12 miles per hour near the ground.

Twenty-eight unburned plots, paired with comparable burned plots, were established throughout the plantation to determine the effects of fire on survival, growth, and hog damage. All plots were measured immediately before burning, and in July and December of 1953.

FIRE LOSSES

Needle scorching by fire was light, considering both the size of the pines and the heavy accumulation of grass and straw beneath the trees. Seventy-five percent of the trees had less than 50 per-

cent of the needles scorched, while only 13 percent were scorched 75 percent or more. Small trees suffered more than large ones. Damage was heaviest on several afternoons when the wind stopped blowing and the trees were scorched before the fires could be extinguished.

Mortality from fire was low, averaging 44 trees per acre or less than 8 percent of the entire stand. Only 11 percent of the trees that were killed exceeded 4 feet in height. Because most of the fire-killed trees were small and not apt to reach merchantable size, mortality was unimportant. Since the summer of 1953 was dry, particularly after July, the low mortality can hardly be attributed to favorable weather conditions.

During 1953, height growth averaged 0.25 foot less on burned than unburned plots. The reduction in growth ranged from 35 percent for trees 2 feet tall to 9 percent for 9-foot trees.

Growth losses were closely related to the degree of needle scorching. Trees with less than 25 percent of the needles scorched grew as much as unscorched trees. Scorching of 25 to 49 percent reduced growth slightly on small trees, but had no effect on trees larger than 6 feet tall. There was a marked reduction in height growth on all sizes of trees with more than 50 percent scorch; the reduction ranged from about 0.5 foot for 50-74 percent needle scorch to 1 foot on trees with more than 75 percent of the crown damaged.

On the whole, burning in this plantation was successfully executed. In localities where there is a high danger from wildfire, such prescribed fires may be justified to remove hazardous fuel accumulations from young plantations. However, prescribed burning of slash pine plantations is risky when the average height of the trees is less than 8 feet. It should be attempted only by experienced personnel under the best possible weather and fuel conditions and where the alternative to prescribed burning is intolerable loss.

Hog Damage

Hog rooting in all of Nebo's plantations was much less in 1953 than in 1952, perhaps because an abundant May hawthorn crop kept the animals in the bottom lands until late in spring. Nevertheless, it was clear that the burned areas suffered less damage than the unburned ones.

Mortality and damage to the 4-year-old slash pine plantation by hogs and prescribed fire were as follows:

Condition of trees:	*Trees per acre* — *Unburned plots*	*Trees per acre* — *Burned plots*
Stand in February 1953	563	568
Killed by fire, 1953	0	44
Total hog damage, 1953	186	26
Killed	44	4
Partially girdled	29	1
Lateral roots damaged	113	21
Alive and undamaged in February 1954	377	498

It will be noted that hogs killed 40 more pines per acre on the unburned plots than on the burned ones, so that the mortality from hogs just about equaled that from fire. But since injured trees were much more numerous on the unburned areas, the advantage was distinctly with the burned plots.

It is important to note that this study leaves unanswered the question of what would have happened if the entire area had been burned—with no choice of range for the hogs.

There are several possible explanations, none of which have been studied, why hogs may avoid burned areas. The ground on burned areas dries out quickly, so that rooting may be difficult and the soil may be an unfavorable habitat for the grubs and worms that the hogs are seeking. The ashes of the fires may also irritate delicate hog snouts.

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Use of Bulldozers in Fire Suppression on Steep Slopes

When building fireline with bulldozer tractors on the under side of fires burning on steep, rough slopes, it is often difficult to include fingers of fire in the main fireline. A method for successfully trenching such fires was worked out on the Payette Forest on the Vaux fire in 1953.

The method, employing two tractors, is as follows: Tractor No. 1 constructs line along fire edge to finger; it cuts through the fire at this point, making a roadway across top of finger as it goes, picks up edge of fire and continues with line building. Tractor No. 2 follows Tractor No. 1, through the finger, and then cuts back along and under the finger making a fireline and roadway to a satisfactory distance beyond the finger of fire. This provides an escape line for Tractor No. 2 in the event of a blowup, because the second line it will build is often so steep that it cannot back up. Tractor No. 2 then backs up to line constructed by Tractor No. 1 at top of finger, recrosses, and completes line around finger.

The practice of cutting through fire when building fireline with tractors should only be employed, of course, when it is necessary to extend the use of the tractor to the "tougher sectors" on steep, rough slopes.—MARSHALL F. YOUNGBLOOD, *District Forest Ranger, Payette National Forest.*

EMERGENCY RADIO REPAIR KIT

W. B. Morton

Communications Officer, Region 3, U. S. Forest Service

Whether he is making emergency radio repair at an isolated fire or a routine maintenance pack trip to a distant lookout, the communication technician needs a lightweight minimum assembly of the basic test equipment. While the assembly of such a kit of test instruments is to some extent determined by the technician's personal preference, there are certain minimum needs that must be met. Choosing the equipment to meet these needs and still keep weight and bulk down becomes a problem.

In studying the various ways in which the bulk and weight of the overall test kit could be reduced, we found significant improvement could be effected through redesign of the indispensable D.C. vacuum tube voltmeter. Most commercial battery-operated V.T.V.M.'s not only are bulky and heavy but also duplicate many functions of the multimeter, which is used for other testing. In order to provide a smaller D.C. vacuum tube voltmeter, we designed and built a simple one to operate from the battery supply already carried in the grid-dip meter. The savings in size and weight in this instrument was enough to reduce the complete kit of test instruments to a compact package weighing only 24¼ pounds.

The vacuum tube voltmeter is built in a 3- by 4- by 5-inch utility box (fig. 1). The complete kit contains the grid-dip meter, power output meter and bridge for antenna and transmitter testing, the D.C. vacuum tube voltmeter, battery tester, and multimeter. Important accessories include flashlight and extra batteries which may be used for the V.T.V.M. supply, spare crystals to use in the grid-dip meter as a signal generator, and a spare battery cable for the V.T.V.M. in case it is desired to use the instrument kit without the grid-dip meter.

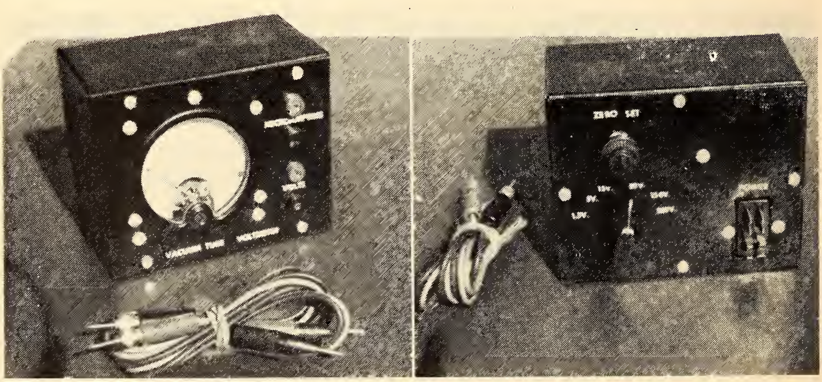

Figure 1.—Front and back views of the vacuum tube voltmeter.

This kit has given excellent service for two field seasons. Placed in a packsack with essential handtools, chemical soldering iron, spare tubes, and parts for the unit to be repaired, the total weight is 32 pounds. While back-pack trips to a repair job are not frequent, the weight is an important factor. This kit has filled emergency needs even at elevations of 10,000 to 12,000 feet where back-packing is more strenuous and a weight saving is not only appreciated but necessary.

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Carrying Case for Chain Saw

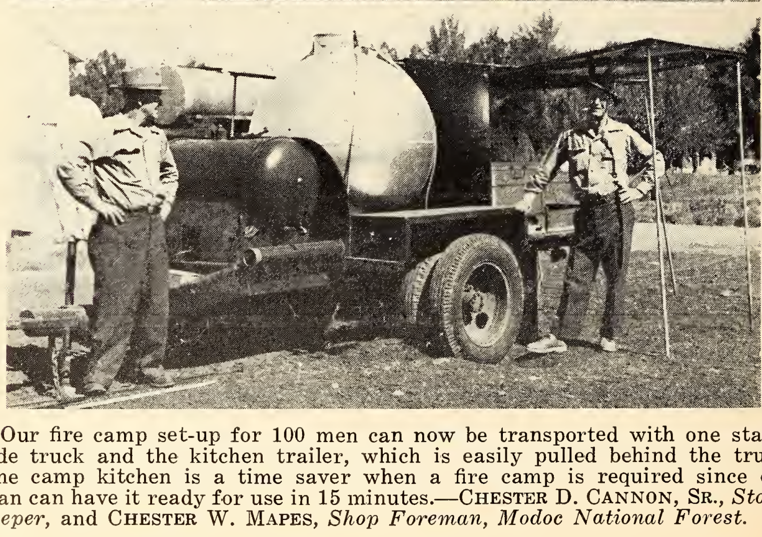
This inexpensive yet convenient carrying case for a one-man chain saw, constructed and tested by the Tallahatchie Research Center of the Southern Forest Experiment Station, greatly simplifies transportation of the saw. It protects the saw, the truck, other cargo, and—most important—the passengers. The design makes possible safe storage or transportation of the saw without removal of the guide bar and chain. This facilitates loading or unloading with a minimum of time and effort.

The case shown is for a 4-horsepower saw with 18-inch chain, but it can easily be adapted for any other small chain saw. The projecting sheath for guide bar and chain is closed on the top and outer end, but is open on the bottom to permit dipping the guide bar when loading or removing the saw. Three-quarter-inch lumber was used, but lighter material or plywood could be substituted.—W. L. GRAHAM, *Southern Forest Experiment Station.*

Trailer Fire Camp Kitchen

The Modoc National Forest has a portable kitchen designed for use in fire camps. The kitchen is set up on a trailer made from the rear axle and dual wheels of a 1½-ton stakeside truck. The cooking unit consists of a 250-gallon butane tank, 40-gallon hot water tank with gas heater, two ovens, and two flattop burners. Gas is piped to a point near the stoves through ⅜-inch galvanized pipe. Flexible pigtails are used to connect the various burners. The butane tank is equipped with safety devices in order to comply with State safety regulations.

The 40-gallon hot water tank is equipped with a ¾-inch faucet, and the heater is directly underneath the tank. The heavy metal shield directly behind the water tank is to eliminate any possibility of heat or flame coming in contact with the butane tank.



Our fire camp set-up for 100 men can now be transported with one stakeside truck and the kitchen trailer, which is easily pulled behind the truck. The camp kitchen is a time saver when a fire camp is required since one man can have it ready for use in 15 minutes.—CHESTER D. CANNON, SR., *Storekeeper,* and CHESTER W. MAPES, *Shop Foreman, Modoc National Forest.*

A MECHANICAL MULE[1]

HOMER W. PARKS

District Ranger, Payette National Forest

In 1953, two citizens of Granger, Wash., invented a mechanical carrier to use on hunting and fishing trips into the Warren District of the Payette National Forest (fig. 1). This rugged little trail buggy is powered by a well-known 2-horse, 1-cylinder, 4-cycle engine with an automatic clutch and a 2-speed transmission with brakes, hand throttle, and a reverse gear. Many of the parts used in it were designed for motorcycles that are known for their speed and dependability over a long period of years. It will climb an 88-percent grade on a dry plank surface. Its closely set tandem wheels pull in unison to give this remarkable performance, and

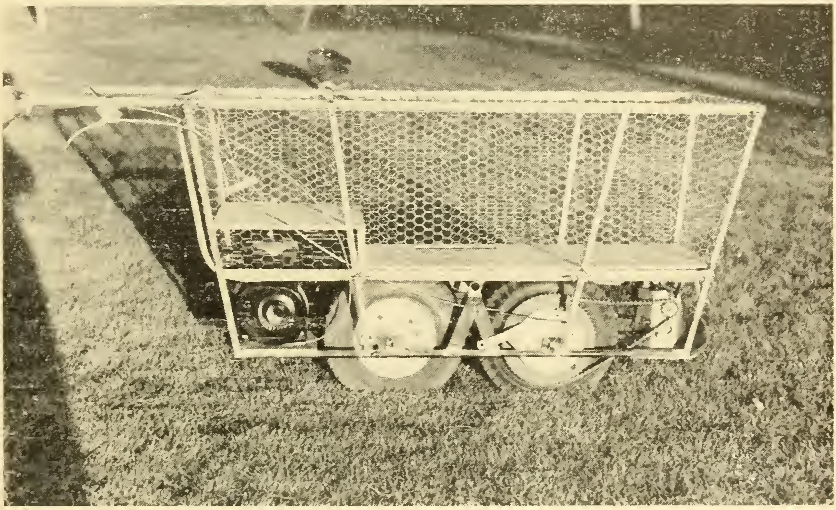


FIGURE 1.—The "mechanical mule."

make it possible for it to climb over obstacles such as logs and rocks. A large basket, 20 inches wide and almost 5 feet long, is mounted over the small wheels. The short wheelbase makes a 90-degree turn very simple. The driver balances the machine much the same as he would a bicycle by walking in the rear and holding onto the handle bars. Transportation of this vehicle from one job to another is simple. It weighs only 170 pounds and can be hauled in a pickup, in the rear of a touring car, or in a plane.

[1] In this article, Ranger Parks enthusiastically describes one type of powered carrier. At least five other models of this versatile machine are being designed, tested, or produced by private and government agencies.—Ed.

In July 1954, Payette Forest obtained one of these mechanical mules with a trail-grader blade attachment. Plans were immediately put into effect to complete a trail-maintenance job by using it instead of horses to carry all tools and camp equipment. Our mechanical mule was operated over 98 miles of pack trails on rough terrain to haul 200 pounds of tools and equipment for an experienced 2-man trail crew. The only mechanical trouble experienced during this time in the field was the adjustment of the carburetor for high elevation, replacement of a key to hold a belt pulley in place on a shaft and the replacement of a spark plug. When it was loaded with the tools and equipment and operated over steep mountain trails in low gear and left with the motor idling a large part of the time, it consumed 1½ gallons of gasoline each week. However, when run with a light load in high gear it averaged 12 miles to 1 quart of gasoline.

The maintenance standard required cutting and removing all logs, and putting up necessary trail signs. The average cost per mile on our forest for this type of work is $12. The trail crew maintained these trails for an average cost of $5.56 per mile. The trails were about average in the amount of work needed.

The mechanical mule was given another test by hauling sand and gravel cross country to a source of water for the Forest Mineral Examiner to make the examination necessary in patent claims. The 10-mile round trip was made in high gear at an average speed of 4 miles per hour, with a small load. The machine will pull the operator along at a dogtrot when it is in high gear. It is very easy to start and operate.

The trail grader was not used because of the dry condition of the river trails. However, tests were made to determine whether the machine had enough power to handle it. The test proved that the machine will push a trail grader or pull a fire trencher. Plans are made to use it for these purposes in the 1955 season.

Very little time is required for lubrication and maintenance of the carrier. Wheel bearings should be greased about once a year. The oil will run a season on trail work without becoming dirty. However, the air cleaner should be cleaned at least once a week when working on dusty trails. Tools required for the maintenance: a pair of pliers, a small crescent wrench, a screwdriver, and a screened funnel.

Advantages of the mechanical carrier:

1. Convenient to move in a truck or trunk of car from one job to another, thus avoiding trailing of pack stock.

2. Avoids time loss common with horses and/or mules in gathering them, packing up, and finding feed on the job, etc.; also eliminates trouble caused by unrest of stock while working.

3. Two-man crew can do the same amount as three with pack stock.

4. Can use workers not familiar with horses.

5. Simple to maintain and operate.

6. Adequate for attachments such as a light trail grader and fireline plow.

7. Can be dropped from plane for emergency use.

8. Suitable for hauling sick or injured personnel from back country to road heads; avoids delay.

9. Two forward speeds and one reverse.

10. Proved capable of climbing an 88-percent slope on a dry-plank surface.

Disadvantages:

1. Limitation on amount of cargo it can haul shortens period crew can stay on job. Under tests, ration-type food supplies and small down beds were used.

2. Crew must be good hikers.

3. Difficult to ford streams more than 6 inches deep.

4. Limited to travel over cleared trails; would not be practical to go cross country where down trees were numerous.

5. Lack of emergency brake.

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Nitrate Airplane Dope for Mounting Maps

Glacier National Park has experienced difficulty for years in keeping lookout firefinder and dispatcher maps from wrinkling and pulling loose from the mounting base whether it be of wood or metal.

Shellack, varnish, and other adhesives of various kinds have been tried with varying success, generally poor. It seemed that we were constantly replacing firefinder maps and usually the replacement was in as poor condition as the replaced map by the end of the season.

Apparently we have solved this problem by the use of nitrate airplane dope. Maps that were mounted last year are still in perfect condition. Cohesion with the base is perfect and there is no sign of wrinkling.

The actual work involved in mounting the maps is much less than that for any of the old methods we were using. One light application of the dope on the mounting base is all that is necessary. The map, being dry and free from adhesive, can be rolled for easy handling and placed in its proper position, after which it can be unrolled while working out the slack and air bubbles with the hands. A rubber roller (photographer's brayer) lightly applied will seat the map firmly on the base while removing most of the bubbles, and without apparent distortion. Remaining bubbles can be reduced in the usual way with the prick of a pin and use of the roller. A light application of the dope over the face of the map after it has dried on the base will protect it indefinitely without cutting the ink on the map.

This dope dries quickly so the map must be placed on the dope in a hurry. On large map mounts, it is often necessary to apply dope and place the map on only part of the mounting base at a time.

The dope can be readily acquired from any air service installation where repairs are made to fabric covered planes. Cost is approximately $3.85 per gallon. A special thinner for the dope is necessary and is also readily acquired. We have used approximately one-half gallon of dope and one quart of thinner in mounting twenty maps ranging in size from the Osborne firefinder maps to large 3- by 4-foot dispatcher maps without one failure.—S. H. Spurgeon, *Fire Dispatcher, Glacier National Park.*

SAWDUST BOX FOR FIRE STRATEGY TRAINING

John W. Cooper

Assistant Forest Supervisor, Mississippi National Forests

All rangers, forest supervisors, and other forest managers responsible for training fire crew foremen have for many years racked their brains for new and better ways of teaching fire strategy through simulated methods: blackboard, mimeographed problems, string on the ground, etc. Last fall Forest Supervisor E. R. De Silvia fell back on his grammar school training days for the answer to this ever present problem. He came up with the idea of using a sandbox and appropriately labeled "flags" on swab sticks to identify equipment, manpower, and so on. He further suggested the use of some sort of paste to symbolize firelines, creeks, roads, and natural barriers.

After the table was built on the Chickasawhay District, dampened sawdust was found to stand up better and to serve the purpose more effectively than sand. It is lighter in weight, cleaner, and easier to work. As a matter of fact, mountain topography involving a range of over 4,000 feet in elevation set up as the last problem at the first fire training school was still intact and usable at another school 3 weeks later.

The sawdust training table is simple and inexpensive to construct and can be built by even an amateur carpenter. A frame of the desired dimensions is constructed from 2- by 6-inch lumber with the top of the "floor" joists 30 inches above the floor. The frame is then floored with 1 by 4's, S4S, over which cheap roofing felt may be placed, or the table floor may be built with tongue-and-groove boards and the roofing felt omitted. Lengths of 2 by 6 are then set edgeways around the border of the table to serve as side boards.

If later use of the sawdust training table is to be expected in the same or other locations, the table may be constructed with bolts and nuts rather than nails in order to facilitate dismantling and storage. This will obviously be a little more expensive than using nails, but storage and future use of the training table will be easier.

Representation of the natural features was successfully solved by the use of outside paint thinned approximately one-third with turpentine. The paint was applied to the "sandbox" from a pint mayonnaise jar in which a short ¼-inch copper spout was welded through the top of the jar. A small breather hole was made in the opposite side of the top. Blue paint was used for creeks, white for the roads, yellow for natural barriers, and, of course, red for the fireline.

Visualization of the characters can be enhanced by use of toy model tractors, trucks, and men. Different colored models can be used to represent different types of equipment, the Fire Boss, and other classes of personnel.

The original training table was 10 to 10 feet, but it is recommended that one dimension be reduced to 8 feet in order to facilitate simulated fire movement and the moving of equipment and personnel or labels as the training progresses. The table may be 10 or more feet in length as desired.

In preparation, the instructor lays out the sawdust table to scale. Roads, creeks, and natural firebreaks are shown as they actually exist in the area of the fire to be discussed. One advantage of this method is that the entire fire need not be shown at first, but rather the outline of the fire at different time intervals during the course of its run. It is then possible to show the location of line constructed and lost and point out the respective mistakes made by different crew foremen in the location of their lines or other significant facts at various points in the attack.

A blackboard, chalk, and eraser should be on hand to record time, season of year, wind velocity, days since rain, danger class, etc. Several 6-foot pointers should be available to the instructor and to the trainees on each side of the table so that they can point out questions at different locations.

When the first simulated fire problem is completed, the topography of that fire can be wiped off the table and new topographic features set up in about 5 minutes. It was our experience with this training device that all grades of employees were able to readily visualize and understand the problems being described. All trainees expressed the opinion that this was the most realistic and effective means of teaching fire strategy that they had ever seen.

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Keeping the Forests Green in Beech River Watershed

This is the title of an 8-page brochure, issued jointly by the Tennessee Department of Conservation, Division of Forestry, and the Tennessee Valley Authority, Division of Forestry Relations, in November 1954. It explains briefly the fire problem in relation to the watershed, the fire prevention project jointly planned and financed, and what the job of preventing fires means to the residents of the area.

MORE ABOUT THE TRACTOR-DRAWN FIRE RAKE

JOHN S. CROSBY, *Forester, Columbia Forest Research Center, Central States Forest Experiment Station, U. S. Forest Service,* and LEE C. FINE, *formerly District Forester, Missouri Conservation Commission*

A tractor-drawn fire rake was described in the July 1952 issue of *Fire Control Notes*. At that time the rake had not been thoroughly tested. Since then it has been used on more than 50 fires and to make and maintain firebreaks on the Sinkin Experimental Forest near Salem, Mo.

The rake is a narrow, rugged version of a side-delivery hay rake developed by a manufacturer at the suggestion of the Forestry Division of the Missouri Conservation Commission. It is designed for use with a farm tractor. The rake is attached to the tractor by a three-point hitch and can be raised and lowered with hydraulic controls. The raking mechanism is driven by a "V" belt from a pulley connected by a drive shaft to the tractor power takeoff. For increased traction in the woods, the tractor is equipped with bombardier treads, and weights are attached to the front wheels (fig. 1).

FIGURE 1.—The mechanical fire rake loaded on a tilt-top trailer ready to be towed to a fire by pickup truck. The rake and tractor can also be loaded on a 1½-ton stake truck.

The rake is sturdy and relatively trouble free. Since the rakers are belt driven, the belt slips if the rake is jammed. The raker teeth may be bent on rocks and stumps but can be straightened many times before they break or wear too short. Tooth life varies with the condition of the surface and the skill of the operator. However, a set of teeth costing about $15 can be expected to rake about 25 miles of line.

The only serious breakdown to date occurred when two cast iron spokes of the spider wheels broke off dropping one whole line of rakers. Even so, the machine was kept in operation for several hours and continued to rake a very satisfactory line. The possibility of this type of breakdown has been practically eliminated on later models of the rake by substituting disk wheels for the cast iron spider wheels used on earlier models (fig. 2).

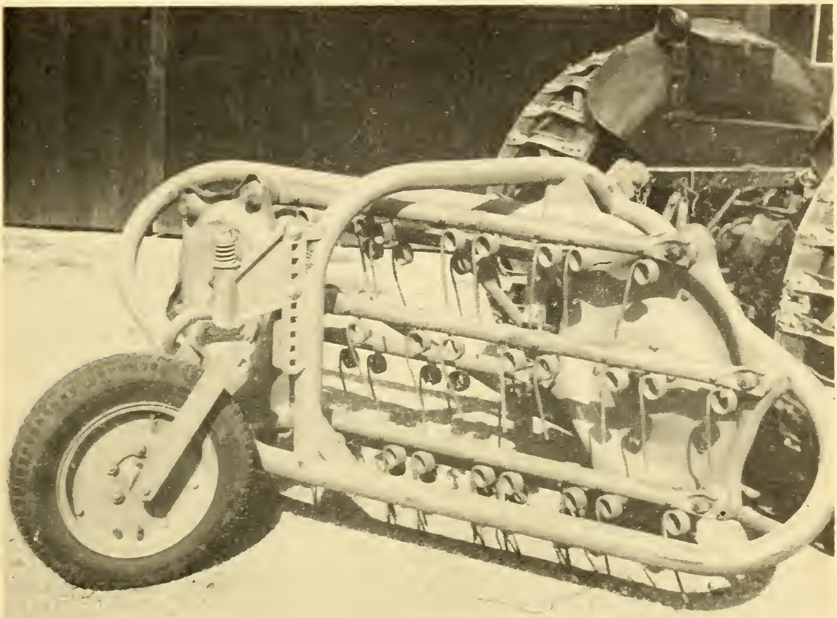

FIGURE 2.—The tractor-drawn fire rake, showing new type disk wheels to which the raker arms attach.

Capabilities and Limitations

Few if any machines yet developed for use in fire suppression operate successfully under all conditions. The mechanical fire rake is no exception. In general, the quality of line made by the rake and the ease of operation are greatest in relatively open timber on level to rolling topography. Difficulty of operation increases as the trees become thicker and as the slope becomes steeper. Quality of line is decreased by running over small trees and slash and by heavy grass.

The rake is most easily operated in open sawtimber stands or lightly stocked stands of poles, saplings, or reproduction, and along old trails. These conditions permit the operator to rake a good line with little help. In stands of poles, saplings, or reproduction of medium density, the operator will need some help from a line locator or axman, but still the rake will do most of the work.

The rake is more difficult to operate in dense reproduction, saplings or poles, and scattered slash. The tractor will go through dense reproduction, small saplings, and light slash unassisted but the quality of line is greatly reduced because the rake cannot clear a line through bent-over saplings and sprouts. However, a satisfactory line can be made if a line locator and/or axman works ahead of the rake and cuts any trees that would either stop the machine or prevent the rake from operating effectively.

Under favorable ground conditions the unit can be operated effectively on slopes up to 40 percent for up and down travel and 20 percent for travel on the contour. Under more difficult conditions of footing and cover, the limits of slope for safe operation will be reduced. The hazards of operating a tractor on rough, sloping land should always be kept in mind.

The rake is most effective for clearing a line through typical forest litter found in the Missouri Ozarks. It also will comb leaves and light debris out of blueberry bushes and similar low-growing vegetation, making acceptable line in a situation where it is difficult to clear a line with hand rakes. The rake will not clear a line in heavy perennial grass, but by setting the teeth to dig and by making several trips a usable line can be made through annual grasses.

The rake will not clean out short, sharp depressions perpendicular to the line of travel because the tail wheel holds the rakers off the ground as they pass over narrow ditches or holes.

Very few soil conditions found in Missouri will limit the operation of the rake. However, areas of large boulders would seriously interfere with effective operation.

Since the rake moves all debris to the left, it is necessary to travel clockwise around the fire in order to throw the litter away from the fireline. If more than one trip is made over the same line, the second trip is most effective if made in the same direction.

Speed of Operation

In open woods, flat country, and along old trails, the tractor and rake made about 200 chains of single line per hour. In dense pine pole stands on rolling land, the rate was only about 30 chains per hour. In raking the original firebreak lines under moderate to difficult conditions of slope and cover but with some distances along roads, the average rate was about 53 chains of line per hour for more than 320 chains of line. Of this amount, 190 chains were raked twice, and 26 chains were raked three times. The total distance raked was 516 chains and was made at a rate of more than 86 chains per hour.

Speed of operation is important, but only as it contributes to the final product—held line. In easy-going terrain, the machine works much faster than a small crew can hold line. Hence the speed may be wasted. When a small crew is working with the machine under these conditions, the machine is usually operated three times over the line—twice ahead and once back, working

small sections of line. This relieves the crew of most of the raking so that they can concentrate on burning out and holding the line. In difficult terrain, a single line built by the tractor and rake may require some additional hand raking before burning out. The rate of building held line, therefore, is variable with crew size up to the maximum speed of the machine.

The rake has seldom been used in initial attacks on average fires but has been held as a reserve unit. It has been very effectively used on long flanks of large fires, releasing manpower for the heavy work on the headfire or for other fires. It has been used by a small crew to build line all around fires of 10 to 15 acres under moderate to high burning conditions.

The Jeep as the Power Unit

The fire rake can be attached to and powered by a ¼-ton, 4-wheel drive jeep equipped with a three-point hitch power takeoff and hydraulic control. To attach the rake requires only two modifications in the hitch. An adapter is required to accommodate the different sized splines of the rake drive shaft and jeep power takeoff. Using the adapter necessitated shortening the rake drive shaft by 4½ inches.

The jeep-mounted fire rake has been tested only on firebreaks. Downslope operation was slightly better controlled with the jeep than with the tractor on a 40 percent grade, but the jeep did not operate uphill successfully on slopes exceeding 35 percent. Because of its longer turning radius, the jeep was less maneuverable in tight places than was the farm tractor equipped with bombardier treads.

The quality of line produced was the same for the jeep as for the farm tractor (fig. 3). It was necessary to drive the jeep in its lowest gear in order to have the raker teeth revolve fast enough to clean a path. However, the low-speed range of the jeep is near the maximum speed for most conditions and is adequate for line building.

Transporting the Unit

In moving the rake short distances such as on the fireline, either machine has enough speed for quick transfer. In moving from fire to fire or from headquarters to fire, the tractor should be transported on a trailer or truck. A tilt-bed trailer pulled by a pickup truck can be used to good advantage (fig. 1).

The jeep can carry the rake in lifted position at 30 miles per hour on highways. A lock is needed to take the load off the hydraulic system and as a safety measure to insure that the rake does not drop down in transit.

The rake can be attached or detached from either power unit in 5 minutes.

Experience has shown that where operation of the unit is practical, the fire rake can replace from 6 to 15 men with broom rakes.

FIGURE 3.—Line raked by mechanical rake attached to jeep. The rake is being taken over the line for the second time through a heavy drift of oak leaves. Note spider wheels reinforced by round iron welded to each spoke; the newer models have disk wheels.

Under favorable conditions of cover, topography, and fuels, the machine is well adapted to raking firelines in the hardwood and pine litter prevalent in Missouri's forests.

Woods fires in Missouri spread in leaf litter commonly varying from ¼ to 4 inches deep. For many years it was easy to build line with hand rakes because frequent burning prevented a normal forest floor from developing. However, now that protection against fires is much more effective, the forest floor is becoming better developed, litter is more compact, and low-growing shrubby vegetation and sometimes sprouts are more abundant. All this makes the job of hand raking slower and more difficult. Power tools, such as the one described here, can help to increase speed of line building and reduce acreage burned.

VALUE OF A PER DIEM GUARD SYSTEM FOR FIRE CONTROL IN SOUTHWESTERN UTAH

FLOYD C. NOEL

District Forest Ranger, Dixie National Forest

The Pine Valley Ranger District on the Dixie National Forest is made up of 198,000 acres of wild land, including and surrounding the Pine Valley Mountains in the extreme southwest corner of Utah. Elevations range from 10,324 feet at the top of Burger Peak to about 2,350 feet at the forest boundary on the south end of the district. The highest mountain range supports a stand of spruce and fir. Next to this is a yellow pine, mountain-mahogany belt. The fuels on the lower benches are the highly flammable manzanita, silktassel, live oak, and pinyon juniper types (fig. 1).

On this medium hazard forest there are periods when the brush and other fuel types build up to high burning indexes and create a definite threat. This district constitutes one of the highest fire hazard districts found in the southern part of the Intermountain Region. In spite of this, during the 13-year period 1941-54, only one fire has spread to larger than Class A size in the timber type, and seven fires have reached Class B size and larger in the brush type. No lookouts are maintained on the mountain peaks, but a per diem guard system has been in effect for this period, and has proved to be the backbone of fire control in this area.

During the period from 1941 to October 1954 there have been 35 fires on the district. First discovery was made on 15, or 43 percent of the total, by a per diem guard. Twenty-three percent were first discovered by Forest Service personnel and 34 percent by all others. First attack and control on 27 of these fires, or 77 percent of the total, was accomplished by per diem guards, while other cooperators made the first attack on 8 fires, or 23 percent of the total.

FIGURE 1.—Typical topography and cover on the Pine Valley Ranger District.

The per diem guards are ranchers and stockmen who live where they have a clear view of the high hazard areas of the forest (fig. 2). They have, for the most part, served for many years and have had fire training at a training school each year or each alternate year since first appointed.

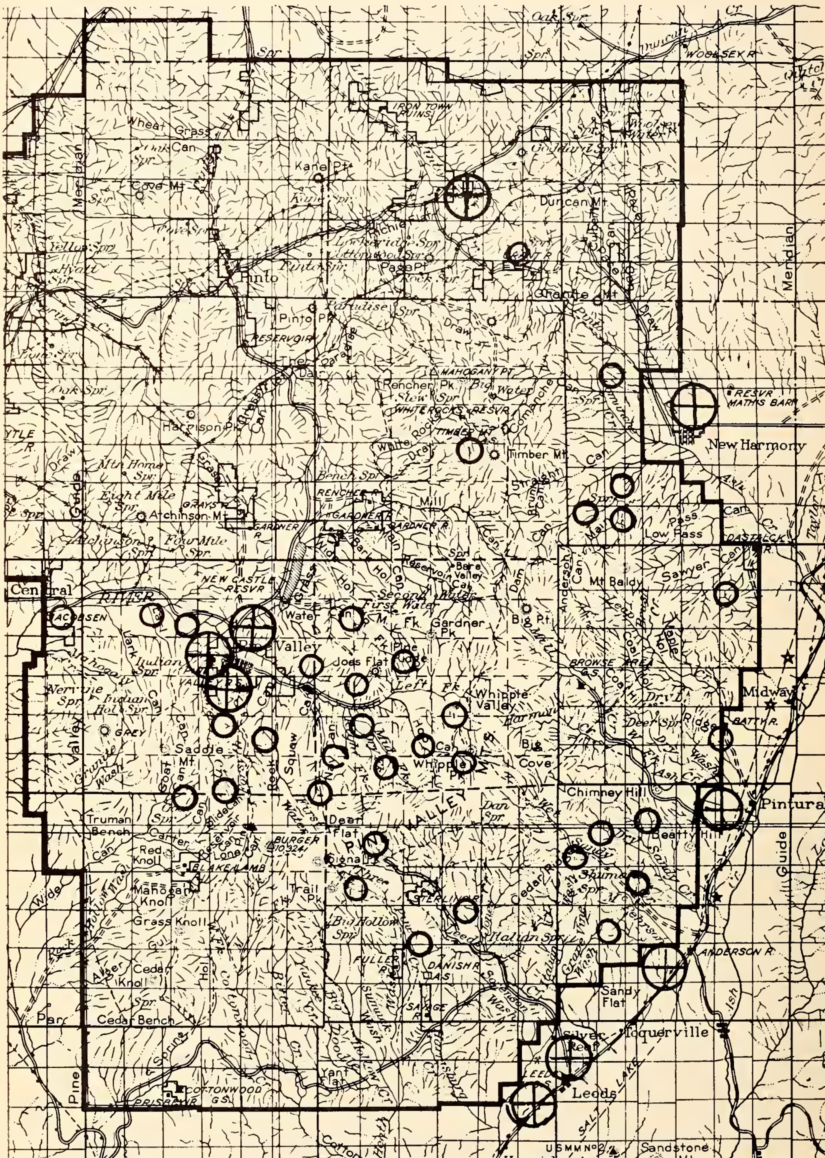

FIGURE 2.—Pine Valley Ranger District. Large crossed circles are per diem guard locations, small circles are locations of fires.

In addition to fire suppression work, the per diem guards give immeasurable service in fire prevention. Understanding the importance of watershed protection themselves, they take advantage of opportunities which arise to caution the public about forest and range fires. Of the 35 fires mentioned above, 5, or 14 percent, have been man caused, and 30, or 86 percent, lightning caused.

Since prevailing lightning and thunderstorms approach from the southeast toward the Pine Valley Mountains, they must literally pass over the heads of four of the per diem guards. Location of the guards puts them in a strategic position to be forewarned and alerted to the possibilities of lightning fires, and thus their get-away time is held to a minimum.

Our experience has been that a well-manned system of per diem guards, strategically located and properly trained, is reliable, effective, inexpensive, and of great value in the control of forest and range fires under circumstances such as prevail in southwestern Utah.

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Fire Report Cards

In the general area of Humboldt National Forest reliance for initial fire control action is most often entirely on local ranchers and other residents. Some of these people act as per diem firewardens. Each takes charge of activities on a fire occurring in his area until relieved by a regular firewarden or forest officer. He relies on his neighbors for help, not only in suppression work but also in having fires reported to him. He in turn reports to the proper agency office whether the fire is on national-forest, private, or Bureau of Land Management land.

In order to facilitate the reporting procedure as well as to make the report more valuable, we devised a fire report card for cooperators to hang on their telephones. It was a mimeographed 3- by 5-inch index card with a place to enter the name and telephone number of the firewarden to whom the report should be made, as well as the following information: (1) Location of fire; (2) size, severity of fire; (3) number of men gone to fire; (4) number of men needed; (5) type of equipment needed; (6) best route to fire.

The State Forester-Firewarden's office later used the idea and supplied all fire cooperators in the State with fire report cards. These were printed in red ink on small shipping tags that had reinforced holes for hanging them up. On the back of the tag were telephone numbers for the county firewarden, forest ranger and supervisor, and the Bureau of Land Management office.

Although we do not always receive all of the information asked for, we find that these cards greatly improve reporting procedure.—Tom E. Brierley, *District Ranger, Humboldt National Forest.*

THREE-POINT TIE DOWN ANCHORS PLOW UNIT ON TRUCK

JOY J. BALDWIN

Forester, Gila National Forest

In hauling our small tractor plow units, we have experienced difficulty in binding tractor and plow down to the truck. It has been necessary to thread a chain through and over the tractor and then under the truck frame, attach boomers, and tighten. The plow had to be chained down likewise, or hauled in a raised position. In the raised position the plow had a tendency to shift the tractor around, raised the center of gravity of the load, and tended to slow up road travel of the truck. Hauling the plow in the raised position, even though locked up, did throw a strain on the attaching plow linkage. Hauling the plow in the down position put excessive wear on the truck bed even though a pad was placed under the point. The pad had to be replaced every few trips. This was especially true during dry weather when the plow is necessarily set at an extreme angle for digging hard soil.

Under the old system of attaching the tractor to the truck several minutes were lost at the fire in getting chains loose from the tractor and plow before it could be unloaded and ready for use. Invariably, if the truck was idle for a few days, the chains would be removed for other purposes and would not be available for binding tractor and plow down when time came for a move. This could cost us a plow unit sometime under blow-up conditions.

The Gila Forest is using a three-point tie down that eliminates these disadvantages. A boot holds the plow point (fig. 1). It is made of ¼-inch boiler plate and is strong enough to prevent a sudden stop or collision from throwing the dozer through the cab.

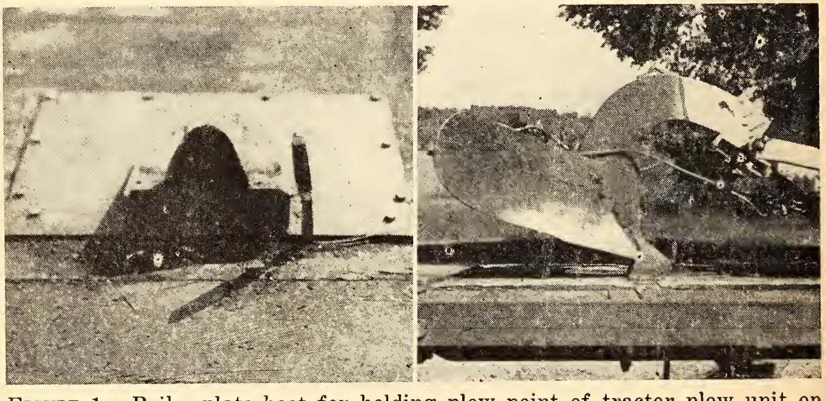

FIGURE 1.—Boiler-plate boot for holding plow point of tractor plow unit on truck bed.

Twenty feet of chain and a boomer are no longer needed to hold the plow down. Four or five links of chain are spot welded to the track carrier frame on each side of the tractor. This chain cannot interfere with tractor operation. A 15-inch length of chain is spot welded on each side of the truck, eliminating about 18 feet of chain. A boomer is required on each side to attach the 15-inch length of chain to the 4 or 5 links on the track carrier frame (fig. 2). The tension forward holds the plow firm in the boot.

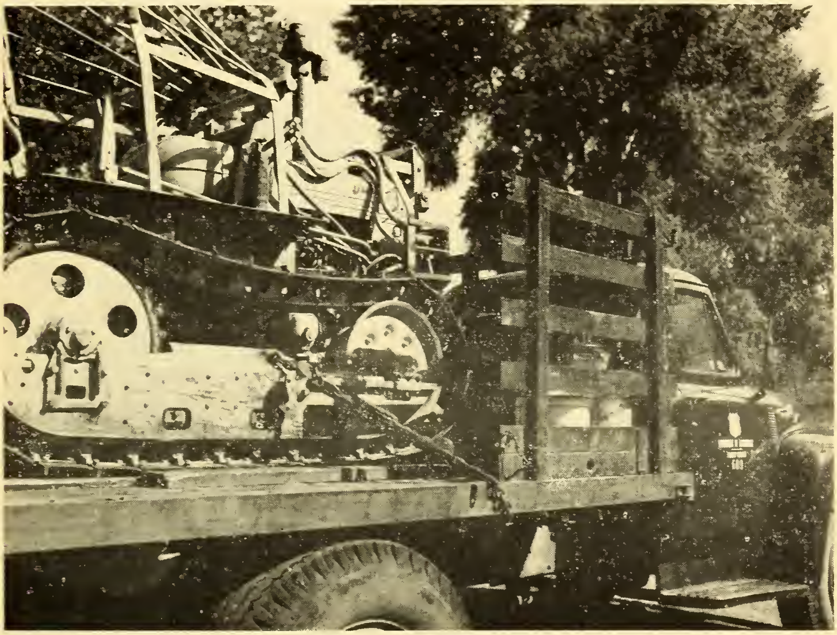

FIGURE 2.—Boomer joining links of chain on track carrier frame to the 15-inch length welded to truck. Forward tension holds plow firm in boot.

In loading or unloading, the driver attaches or releases a boomer on the left side and the swamper hooks or unhooks a boomer on the opposite side and the unit is ready to move out. The chains cannot be lost or removed from the tractor or truck. The boomers can be kept in the tractor toolbox. Time is a big factor and although this method of attaching saves only a few minutes it could be the difference in whether the plow can control the fire alone or whether additional equipment or men would be needed.

STATIONARY MOUNT FOR BINOCULARS

T. A. Neff

Assistant Ranger, Mendocino National Forest

A stationary mount for holding binoculars, built by Stanley Johnson, has been in use for the past two summers on Valley View Lookout in the Mendocino National Forest (fig. 1). The purpose of the mount is to hold a "fix" on a distant object; that is not possible when glasses are held in the hands or are stronger than six-power.

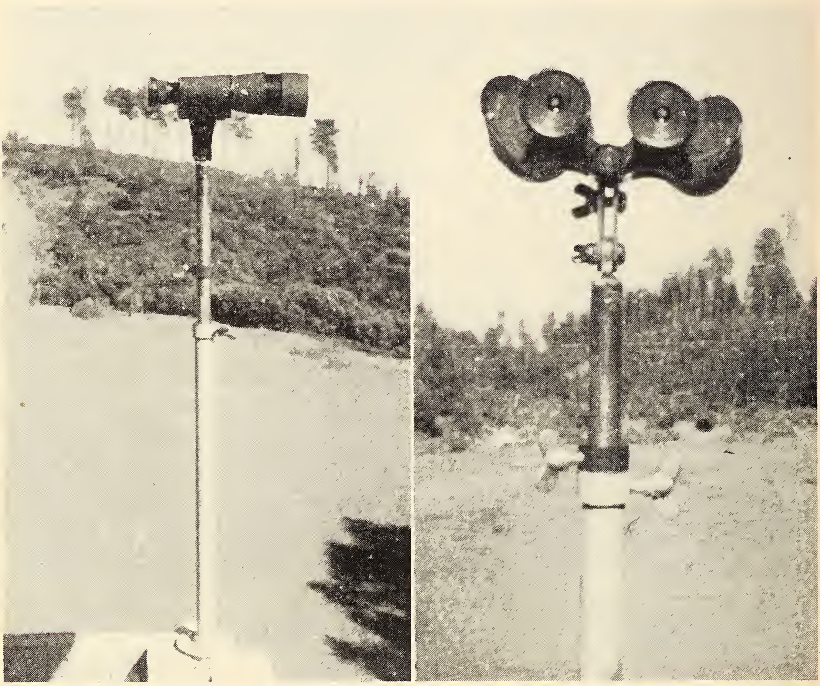

Figure 1.—*Left,* Stationary mount in an adjusted position. *Right,* Closeup of mount, showing wingnut arrangement.

The mount consists of an 18-inch length of ¾-inch pipe with a flange for a base. The top of this pipe is covered with a pipe coupling, cut in half, to make a thicker thread bearing to hold the winged setscrew. Inside of this pipe is a 15-inch length of ½-inch wall conduit that can be moved up or down to adjust the binoculars to the height of the person using the binoculars. Into the top end of this conduit is welded a piece of ¼-inch, ¾ inch wide, drilled through with a 5/16-inch hole. Over the center bar of the binoculars is fastened a clamp made of two pieces of iron 3/32 inch thick, 3 inches long, and as wide as the center bar of the binoculars is long. This clamp is molded so as to make a

snug fit around the center bar; its two pieces are held together by a 5/16-inch bolt and wingnut with split washer near the binocular end and another such bolt and nut near the end that fastens onto the fitting in the top end of the conduit. These wingnuts and split washers give the necessary tension to hold the angles desired and yet provide for both lateral and vertical angles.

To hold the binoculars at the desired height and yet swing them around to any point on the compass, a ½- by 1¼-inch iron collar with a winged setscrew is made to slide up and down over the conduit.

The various joints make it possible to quickly move the binoculars to any any angle, high or low. Separate bases are provided at each of the four corners of the lookout catwalk, and the binoculars with the clamp and inside conduit can be easily moved and used on the base that affords the best look at the area being covered.

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Prevention Action Correlated to Fire-Danger Rating

The February 1954 fire danger on the James River District, George Washington National Forest, indicated the need for special prevention action. Although March 1 ordinarily marks the beginning of the spring fire season in the west-central mountains of Virginia, there was definite evidence that the 1954 season was coming in a month early.

A slight build-up index was noted on Forest Fire Danger Meter Type 8-0 for open-type stations (Southeastern Forest Experiment Station), beginning the latter part of January. By February 10, 1954, the buildup index was 31 and the burning index was 40. The first fire of the month occurred on this day. The last rain (0.04) was 14 days previous to this and the last rain of more than 0.06 was 19 days previous. (Total rainfall in February was 1.07 inches—much below the 4.0-inch normal.) Wind velocities during this 19-day period were recorded up to 14 m. p. h. but fuel-moisture percent did not go below 9.0.

Another factor influencing the unusually early 1954 fire-danger buildup was low ground-water supply—a result of drought conditions in 1952 and 1953. Rapid melting of light 1953-54 winter snows also caused the district's fire danger to climb at a much earlier date than normal. Buildup index in February ultimately reached 48. Recent recognition by the 2 national forests in Virginia of 75 as the "Closure Index" will better evaluate the fire-danger buildup in February.

Risk on the James River District is normally high because approximately 32,000 people live there. Ninety-three percent of these people live within 1 mile of national-forest land. Forest use is correspondingly high. The West Virginia Pulp and Paper Co. mill at Covington, Va., located approximately in the center of the district, uses 1,000 cords of pulpwood daily. The 150,000 acres of national-forest land on the district plus another 150,000 acres of private land immediately adjacent to, and, coming under the district's fire protection boundary, provides much readily accessible acreage to pulpwood cutters. Access to this land is unusually good with a total of 394 miles of primary and secondary roads serving the area. U. S. 60, a main east-west artery, cuts through 40 miles of the district. An estimated network of 150 miles of woods roads may be added to the above figure for timber or pulpwood access. In addition, the Chesapeake and Ohio Railroad traverses

some 60 miles of the district. Although this risk is lessened with diesel use, it is still there to some extent.

The buildup of fire danger as influenced by weather, combined with existing risk created by forest area accessible to people, pointed to the urgent necessity early in February 1954 of warning the public of the increased fire danger. Knowing that debris burning in the early spring is common practice, with most of it being done in February to get ahead of the Virginia Brush Burning Law, that becomes effective March 1, the necessity seemed even more urgent.

The local population was cautioned frequently through news releases, radio broadcasts, and personal contact of the steps necessary to prevent fires. Prevention movies were shown at local schools earlier than usual. Through the combined efforts of all public service agencies, including press, radio, State and local law-enforcement organizations, the County Agent's office, and the Soil Conservation Service, effective leadership was given to the prevention program. Perhaps most noteworthy was the invaluable help of a fire-conscious public in their prevention attitude and assistance.

By concentrating our prevention campaign on certain risks—debris burning, lumbering, children playing with matches, etc.—the number of fires on the district was held to a minimum. Total February 1954 fires, by causes: 3 debris burner (1 Class C, 2 Class A's); 1 smoker (Class A); 1 incendiary (Class C).

In addition to effective fire prevention campaigns, an energetic law-enforcement program is a strong factor in preventing fires from starting. Individuals who pay the costs of suppression remember well the precautions that should have been taken. Lasting benefits are obtained in local communities if the impression can be left that costs of fire suppression are made or that some law-enforcement action is taken on every fire. Of the 5 fires occurring in February on the James River District, collections were made on 4 of them.

Specific conclusions follow:

1. The Type 8-0 Forest Fire Danger Meter will give an accurate warning of approaching danger; especially significant at unseasonable periods.
2. To make appreciable gains in fire prevention, it is necessary to concentrate on specific risks.
3. Fire prevention education must be maintained on a continuing high level to assure the assistance of a fire-conscious public.
4. That where righ risks exist, full public service organization support is necessary.
5. Law-enforcement action results in increased prevention returns.
6. Where district fire-organization personnel is not plentiful enough to contact the desired number of individuals in a relatively short period of time for a pinpoint type prevention effort, *the selection of local key individuals to aid in such work is extremely important.*—JOHN H. NOYES, *District Ranger, George Washington National Forest.*

INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed in the manuscript immediately following the paragraph in which the illustration is first mentioned, the legend being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

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April 1946-October 1955

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

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FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 16 Number 4

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TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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